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China Report

ECONOMIC AFFAIRS

ENERGY: STATUS AND DEVELOPMENT -- 36

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CHINA REPORT

ECONOMIC AFFAIRS

ENERGY: STATUS AND DEVELOPMENT -- 36

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HYDROPOWER

THERMAL POWER

COAL

NATIONAL POLICY

QIAN ZHENGYING URGES REFORM IN POWER INDUSTRY

OW111435 Beijing XINHUA Domestic Service in Chinese 1130 GMT 10 Dec 84

[Text] Beijing, 10 Dec (XINHUA)--By the end of this century China's irrigated farmland must increase to more than 800 million mu and its annual power output to 1.2 trillion kWh in order to quadruple our total industrial and agricultural output value, and the way to achieve this grand goal is through reform. These remarks were made by Minister of Water Resources and Electric Power Qian Zhengying at the national congress of labor models and representatives of advanced collectives in the nation's departments of water resources and electric power today.

How to carry out reform on the water resources and electric power front? Qian Zhengying put forward the following proposals:

1. We must break away from the practice of the last several decades of relying entirely on state subsidies in operating water conservancy projects. We must take steps to enable water conservancy projects management units to develop and turn into enterprises as soon as possible, and to enable existing water conservancy projects acquire the capacity of self-sustenance, self-renewal, and transformation so that a healthy cycle will be created in water conservancy investment.

2. We must break away from the traditional practice of monopoly in operating the power industry, a practice developed in the last several decades. We must take steps to rationally resolve the contradiction between the need of unified control of power networks and the demands from various quarters for decision-making powers in operating and using electric power generated by projects built by themselves. We must fully arouse the initiative of all quarters in building power projects so that everyone--the state, enterprises, collectives, and individuals--will take part in building power projects, large, medium-sized, or small. This is a fundamental way to step up the development of the power industry. Preferential policies and measures should be adopted to stimulate and encourage the general public to explore opportunities and raise money to build power projects.

3. We must break away from the practice of the last several decades of having no clear economic responsibility with regard to investment returns in capital construction. We must link the economic interests of the relevant construction

units with the investment returns from projects. We must institute a system of investment responsibility or public bidding to promote competition and to force the construction units to select the most feasible plans, guarantee quality, reduce construction costs, and shorten the construction period.

4. We must break away from the practice of the past several years of engaging in a single undertaking only. Water conservancy and power units must diversify their businesses while pursuing their principal undertakings. The power industry should gear itself to the needs of society and take the road of business diversification.

5. We must fully appraise the new demands, forces and experiences created in the countryside under the new circumstances. We must use economic leverage, strengthen scientific guidance, and rely on new well-to-do peasants to raise the level of farmland capital construction, water and soil preservation, and rural electrification.

6. We must break away from longstanding closed-door traditions and work hard to create a new situation of international economic and technological cooperation. We should make an effort to attract foreign capital and import foreign technology and equipment for the construction of nuclear power stations, super-high-tension power transmission lines, large thermal power sets, projects diverting water from the south to the north, and other key projects in the Chang Jiang's Three Gorges and the Huang He's Xiaolangdi as well as in coastal open cities where water and electric power are in short supply. We should make an effort to import spray and trickle irrigation techniques and other new technologies.

7. We must break away from the traditional practice of relying on the state for resettling people residing in water reservoir areas. We should take steps to link their resettlement with the development of mountain regions so that their resettlement will benefit development.

CSO: 4013/79

NATIONAL POLICY

RESOURCES POOLED TO EXPAND POWER OUTPUT IN SOUTHWEST

OW121816 Beijing XINHUA in English 1445 GMT 12 Dec 84

[Text] Chengdu, 12 Dec (XINHUA)--Funds are being raised through various channels in southwest China to build power stations to accelerate the development of mineral resources in the region, according to local officials.

This is in line with the call of the Ministry of Water Resources and Electric Power to pool the resources of the state, enterprises, collectives and individuals to build more power stations.

Jiangsu, Anhui, Zhejiang and Shanghai in east China have already taken the lead. They plan to raise 2 billion yuan and add a total generating capacity of more than 2 million kW.

The potential for hydropower in the southwest China provinces of Sichuan, Yunnan and Guizhou is estimated at 270 million kW, 40 percent of the country's total. Coal deposits in the area account for 12 percent of the nation's total. In addition, there are rich mineral resources, especially iron and nonferrous metals, awaiting development.

Sichuan Province has decided to invest 1.4 billion yuan between 1986 and 1990 to build one hydroelectric power station and two thermal power plants.

Guizhou plans to raise part of the funds and join the state in building a thermal power station with a generating capacity of 400,000 kW and a 510,000 kW hydroelectric power station.

According to contracts signed by Yunnan Province and Chongqing City in Sichuan with the Ministry of Water Resources and Electric Power, a 1.25 million kW hydroelectric power station will be built on the Lancang Jiang in Yunnan and a thermal power plant of the same size will be built in Chongqing.

Yunnan Province has already raised 300 million yuan and Chongqing City, 500 million yuan, for the two projects.

Between 1986 and 1990, power stations with a total generating capacity of more than 6 million kW will be put into operation in southwest China. This will help accelerate the development of mineral resources in the region and alleviate energy shortage in Sichuan, local officials say.

CSO: 4010/76

POWER NETWORK

HOPES PINNED ON HVDC LINES TO SOLVE CHRONIC POWER SHORTAGES

HK180307 Hong Kong MING PAO in Chinese 15 Jan 85 p 5

[Special dispatch from Beijing by reporter Tsung Chuan: "Insufficient Electric Power in Open-door Cities; North China Region Suffers Serious Water Shortage"]

[Text] Qian Zhengying, PRC minister of water resources and electric power disclosed recently: At present, mainland China is suffering water and electric power shortages and facing a severe challenge. Qian Zhengying said: "The year 1985 will witness a severe situation in China's water resources and electric power supplies. Should a big flood occur, our plans will be disrupted."

Qian Zhengying also disclosed: Mainland China is suffering serious water and electric power shortages. All the 14 coastal open-door cities are suffering electric power shortages, particularly the Guangzhou area. The northern part of mainland China is suffering a serious water shortage. The water resources in north China are not enough, which will surely affect industrial and agricultural development. So, for the Ministry of Water Resources and Electric Power, this year's work will focus on two aspects: 1) Through reforms, to generate enthusiasm in all parts of the country to work hard to improve the situation in water resources and electric power; 2) to strengthen overall work to open up a new project for water and electricity undertakings during the period of the "Seventh 5-Year Plan." There will be three key construction projects: 1) The construction of nuclear power stations; 2) the construction of electric power stations and the Three Gorges; and 3) the diversion of water from the south to the north.

It is reported that after signing with Hong Kong in Beijing in January the contract for joint operation and the contract for starting construction of the Guangdong nuclear power station, overall construction work will begin and will be completed on schedule with all efforts, so that Guangdong's electric power shortage will be solved.

In order to deal with the relation between small and large hydropower networks, Qian Zhengying will lead a team first to Nanchang to work on the spot, then to Shanghai to deal with the construction of the electric power network in east China.

The woman minister is a well-known expert on water resources in communist China. When answering reporters' questions, she said: The Ministry of Water Resources and Electric Power will start the construction of 10 major projects in 1985; among them, there will be the Gezhouba-Shanghai extra-high voltage direct current transmission line, which she described as "having caught up with advanced technology." This type of high voltage transmission line will be the first one in mainland China. In the world today, only about 10 countries, such as the United States and the Soviet Union, have built this type of transmission line.

Qian Zhengying admitted that in order to accomplish the construction of these 10 huge projects, they need to overcome ultra-leftist factors in guiding ideology and other problems such as insufficient capital. Owing to the lack of capital, the present scale of hydropower construction is far below the required level. As far as electricity is concerned, in the past few years during which the mainland's industry and agriculture have been developing at a growth rate of 10 percent a year and the domestic electric appliances have been developing at a surprisingly high growth rate, although the quota for electric power production has been overfulfilled, the switches still have to be turned off every year. For example, the switches within the second ring road in Beijing started to be turned off last year. Experts on electric power say that the power station capacity which will go into operation this year will be unprecedentedly big, but in the meantime, they predict that the phenomenon of general insufficiency of electric power supply in the coastal areas will still exist even during the period of the "Seventh 5-Year Plan."

CSO: 4013/81

POWER NETWORK

ELEVEN 500KV POWER LINES TO BE ERECTED

OW190838 Beijing XINHUA in English 0826 GMT 19 Jan 85

[Text] Beijing, 18 January (XINHUA)--Work is under way or will begin soon on eleven 500KV power transmission lines as part of China's efforts to improve power supplies, the ECONOMIC DAILY reported today.

The lines, totalling 4,680 kilometers in length, will be linked with the east, north, and northeast China power grids.

Now being built are four lines, including one from Shentou to China's leading coal center, Datong, both in Shanxi Province, and another from Beijing to Tianjin.

Two lines in northeastern China are nearing completion.

Work will start soon on two lines to the biggest industrial city of Shanghai, one from Xuzhou in Jiangsu Province and another from Huainan in Anhui Province. Two other new lines to be built include one from Haicheng to the booming industrail city of Dalian, both in Liaoning Province, and the other from Gezhouba in Hubei Province, China's largest hydroelectric power station on the [Chang Jiang], to a railway hub--Zhuzhou in neighboring Hunan Province.

The country's first 500,000-volt direct-current power transmission line will be built soon between Gezhouba and Shanghai. The line will run 1,080 kilometers through Anhui, Jiangsu, and Zhejiang Provinces and will carry 5 to 6 billion kWh of electricity from central China to the economically developed coastal areas.

CSO: 4010/64

POWER NETWORK

NEW CABLE TO FEED POWER TO OFFSHORE ISLANDS

OW260943 Beijing XINHUA in English 0912 GMT 26 Dec 84

[Text] Xian, 26 Dec (XINHUA)--China's first direct-current power transmission equipment, which will supply electricity to the Zhoushan Islands off Zhejiang Province, has been approved at an assessment meeting here.

A key project for the Sixth 5-Year Plan (1981-1985), the equipment was manufactured for a 100,000-volt cable from the coastal city of Ningbo to the islands. The total length is 56 kilometers, including 11 kilometers under water.

The Zhoushan Islands lie in the country's largest fishing ground in the East China Sea. The new equipment, an advanced means of power transmission over long distances, will supply the islands with electric power for developing industry and fisheries there.

CSO: 4010/76

POWER NETWORK

BRIEFS

NEI MONGGOL TRANSMISSION LINE--A 177-km-long 220,000-volt power transmission line between Yuanbaoshan and Daban was completed on 25 December 1984 and will be put into operation before the Spring Festival [Hohhot NEIMENGGU RIBAO in Chinese 17 Jan 85 p 2 SK]

NEI MONGGOL POWER NETWORK--By 25 December 1984, the Hohhot-Baotou Power Network in Nei Monggol had generated 3.655 billion kWh of electricity, prefulfilling by 16 days its 1984 power production target. [Excerpt] [Hohhot NEIMENGGU in Chinese 2 Jan 85 p 1 SK]

GUIZHOU 1984 ELECTRICITY OUTPUT--In 1984 the province generated 6.842 billion kWh of electricity, equivalent to 100.62 percent of the annual target, an increase of 10.02 percent compared with the previous year. The total amount of power supply was 5.366 billion kWh, an increase of 3.3 percent compared with the assigned target. In addition to meeting the power demand in the province, it has transmitted 769 million kWh of electricity to Sichuan and 98.92 million kWh of electricity of Yunnan, thereby realizing 189 million yuan of profits, an increase of 8.28 percent compared with the same period the previous year [Guiyang Guizhou Provincial Service in Mandarin 2300 GMT 20 Jan 85 HK]

HEILONGJIANG 1984 POWER OUTPUT--As of 21 December 1984, Heilongjiang Province's power industry had comprehensively fulfilled the state-assigned power generating, and installed, and energy conservation plans. The province generated 15.06 billion kWh of electricity, an increase of 7.5 percent over 1983. The installed capacity for capital construction was 300,000 kilowatts. [Harbin HEILONGJIANG RIBAO in Chinese 25 Dec 84 p 1 SK]

HEILONGJIANG 220KV POWER LINE--Recently, the Heilongjiang Provincial Power Design Institute completed its task of surveying and designing of a 220-kilovolt extrahigh power transmission line project. It is a subsidiary project of the Shuangyashan Power Plant, which is under construction. The transmission line is 320 kilometers in length. [Harbin HEILONGJIANG RIBAO in Chinese 25 Dec 84 p 1 SK]

SHANDONG POWER LINE--Yantai City, Shandong Province has completed building the 120,000-kilovolt-ampere transformer project at Wendeng County and the 220,000-volt high-tension power transmission line between Longkou Town, Huangxian County, and Wendeng County, which is 173.2 kilometers long. These

projects cost the province 18 million yuan. Once these projects are put into operation, Yantai City will have a one-third increase in its power supply. [Jinan DAZHONG RIBAO in Chinese 30 Dec 84 p 1 SK]

GUANGDONG 1985 POWER CONSTRUCTION PLANS--This year Guangdong Province has arranged investment funds of some 308 million yuan for electric power capital construction. It has been learned that the provincial electric power department has now initially arranged these investment funds for seven electricity generation projects and 24 electricity transmission and transformer projects. The Shaoguan power plant is to expand its generator unit to a 200,000-kilowatt generator unit, which must be put into operation on an experimental basis before the Spring Festival this year and must be formally put into operation in April. [Guangzhou Guangdong Provincial Service in Mandarin 1000 GMT 14 Jan 85 HK]

HEBEI 500KV LINE--Full-scale construction of the Langfang-Tianjin section of China's third 500KV ultra-high tension power line is now under way. This power line extends westward to Fangshan in Beijing and eastward to the northern suburbs of Tianjin. The project is one of the key state construction projects. [Excerpt] [Shijiazhuang HEBEI RIBAO in Chinese 13 Nov 84 p 1]

SHANDONG POWER TRANSMISSION PROJECT--After 16 months of strenuous efforts, a 220,000-volt power transmission and transformation project went into operation in Shandong Province on 31 December 1984. The power transmission line runs between (Huangtai) and Linyi. Operation of this project can double the power supply capacity, thus easing Dezhou Prefecture's power shortage situation. [Summary] [Jinan Shandong Provincial Service in Mandarin 2300 GMT 8 Jan 85 SK]

CSO: 4013/74

HYDROPOWER

PROSPECTS FOR HYDROPOWER CONSTRUCTION TO YEAR 2000 OUTLINED

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 10, 12 Oct 84 pp 15-20

[Article by Lu Qinpei [7120 2953 0160]: "Prospects for Hydropower Development To the Year 2000"]

[Text] I. Necessity and Favorable Conditions for Preferential Hydropower Development

Under the general objective of quadrupling the total industrial and agricultural output value in China's economic development by the end of this century, hydropower generation as an energy development and a component part of the electric power industry should contribute as much as possible.

At present, the level of development and utilization of hydropower resources in China in terms of electric power quantity is merely 4.5 percent. The proportion of hydropower in primary overall energy production is also only around 4 percent. Both of these percentages are lower than other countries in the world and are lower than some developing countries such as Brazil, where they are 13 and 27 percent respectively.

The favorable conditions of preferential development of hydropower in China are as follows:

1. Hydropower resources have been more clearly surveyed. After two surveys since Liberation, particularly the general survey in 1978-1980, we have not only reexamined our theoretical hydropower reserves, but based on the data from survey programs of many years we have made an overall calculation of hydropower resources that can be developed according to the various technical and economic targets for cascade hydropower stations planned for each river so that results are more reliable. On this basis we can make a preliminary selection of projects with better conditions for development.

2. For over 30 years we have conducted different levels of surveys and studies of some river sections and main cascade hydropower stations with relatively good conditions for development. Apart from the more than 24 million kilowatts of large, medium-sized, and small hydropower stations completed by the end of 1983 and 10 million kilowatts which are under construction, 181 projects with a total of 73 million kilowatts are being planned and designed with an annual power output of 326 billion kilowatt-hours. Of these, preliminary design and feasibility studies have been

completed for 30 large and medium-sized hydropower stations with a total of 30.56 million kilowatts which will provide a considerable reserve for speeding up hydropower construction. It can be expected that after the system reform and adoption of advanced survey and design measures, the pace of preconstruction work will further increase and technical quality will further improve.

3. At present there are 20 directly subordinated hydropower construction units with more than 250,000 staff and workers. Some provinces and regions even have engineering bureaus. They are not fully linked up with construction tasks and some remain idle so that the potentials are considerable. Some large engineering bureaus have quite a lot of construction machinery and equipment but their utilization rate is low. Therefore even more hydropower construction tasks can be taken up by organizing all the construction capability.

4. After more than 30 years of practice we have accumulated considerable experience in hydropower planning, survey and design, scientific research, and construction and operations. By self-reliance we have built 21 large hydropower stations including the Liujiaxia hydropower station with an installed capacity of 1.16 million kilowatts and Gezhouba hydropower station of 2,715,000 kilowatts now under construction. We have built 15 different types of high dams over 100 meters high including 165-meter-high Wujiangdu gravity-arch dam built in a karst region which has complex geological conditions. In the future, along with scientific and technological development and the import of advanced technology, we will be able to take on more arduous tasks.

5. Ninety-two percent of the hydroelectric generating units in China are domestically made, the largest being 300,000 kilowatts. In the course of future development, with the exception of the need to import technology for new generating units such as the extra-large 500,000-600,000 kilowatt units and pumped-storage units, other ordinary units can be produced by ourselves. In order to satisfy the need for even more generating units for development in the 1990's, expanding the current production capacity is relatively easy.

Hydroelectric generating units have flexibility and speed in starting up and are suitable for the job of peak and frequency modulation in the power system as well as for emergency use. It is therefore possible to maintain a balanced power generation and shared base charge between thermal power and nuclear power units, increase the efficiency of power generation, economize on fuel and lower power generation cost.

7. Based on the budgetary estimate after the "five-fixes" of various large and medium-sized hydropower stations under construction, the average investment per kilowatt is 1,560 yuan; for new thermal power plants it is 700 to 800 yuan per kilowatt. But considering the corresponding investment in coal mines and rail shipments of coal, the state would have to invest an additional 700 to 800 yuan for each kilowatt so that the total comprehensive investment is still around 1,500 yuan, and investment in such environmental protection measures as desulfurization facilities has not been added. Hydropower construction frequently also includes benefits of comprehensive utilization such

as flood control, irrigation, shipping, and tourism; on the other hand, the power transmission distance between a hydropower station and the center of power consumption is frequently long. Therefore, in short, the comprehensive costs of hydropower and thermal power differ little. However, after a hydropower station is built, because it does not use fuel and the number of operation and control personnel is small, its power generation cost will be much lower than that of thermal power, moreover, it will not be affected by increase in the price of coal. Therefore, in view of the overall situation and long-term considerations, generally speaking hydropower stations are economically more rational.

II. Tentative Goals of Development

Considering China's energy supply and conditions of transportation and from the viewpoint of rational utilization of energy resources and macroeconomics, we should develop hydropower as much as possible. In the light of the forecast on the needs of electric power development in all regions and having studied and selected the large and medium-sized hydropower projects which may be developed in the near future, the design and construction capacity that can be arranged and the scale of small hydropower stations in various provinces and regions that can be developed, we make the preliminary assumption that by the year 2000 the total installed capacity of hydropower will reach 80 million kilowatts and at the same time we should actively initiate conditions and strive for even more. Of this, 20 million kilowatts or more must come from small hydropower stations. This will quadruple or slightly more than quadruple the 20.32 million kilowatts in 1980. At that time, the level of utilization of hydropower resources in China will correspondingly increase from the present 4 percent to 13 percent or more. The proportion of hydropower in primary total energy output will be increased from 4 to 8 percent. The proportion of hydropower in the total power generation should be somewhat higher than the average of 21.6 percent during the 10 years between 1974 and 1983. We believe that attaining 80 million kilowatts by the year 2000 and maintaining the present proportion of hydropower is the minimum program.

Over the more than 30 years since the founding of the state, the installed capacity of hydropower in China has grown from 163,000 kilowatts in 1949 to 20 million kilowatts in 1980 at an annual average growth rate of 16.8 percent. This rate is very high. However, the Sixth Five-Year Plan (1981-1985) estimates an increase of more than 6 million kilowatts in hydropower (only 3.3 million kilowatts from large and medium-sized stations and 2.7 million kilowatts from small stations). This is lower than the actual increases of the two previous 5-year plans. According to the statistics, the increase in the Fourth Five-Year Plan was 7.14 million kilowatts and that in the Fifth Five-Year Plan was 6.89 million kilowatts. The annual average growth rate was 16.6 percent in the Fourth Five-Year Plan, 8.6 percent in the Fifth Five-Year Plan, and 5.4 percent in the Sixth Five-Year Plan, which is increasingly smaller. This was mainly the result of the "cultural revolution," transfer of design and scientific research units to the grass-roots level, poor preconstruction work, fewer new projects and scale of stations under construction being too small. Consequently the current speed of development is affected.

In the Seventh Five-Year Plan the production scale of large hydropower stations has basically been decided, and new construction will not enable production to begin before the year 1990. If we stress the construction of a number of medium-sized hydropower stations, the scale of production may increase somewhat, and as for small stations we must develop 100 rural electrification counties and consider an increase of 4 million kilowatts within 5 years. In this way, there can be an estimated increase of more than 13 million kilowatts in this 5-year plan at an annual average growth rate of 7.9 percent.

The production scale of hydropower in the Sixth Five-Year Plan is basically a foregone conclusion. The total increase during the first 10 years is over 18 million kilowatts, which is not even doubling, and we must speed up development in the following 10 years. It is hoped that during this period we can earnestly succeed in "gradually shifting the emphasis to hydropower."

The scale of hydropower stations under construction remains relatively small. Currently there are 24 large and medium-sized stations under construction with a total possible capacity of more than 12 million kilowatts. Most of these projects can begin production before the year 1990 and the balance of a mere 3.5 million kilowatts will be carried over to the Eighth Five-Year Plan and this deserves a great deal of attention. We belive that there must be sustained growth in the economy and only with the Eighth Five-Year Plan as a foundation can we initiate conditions for the smooth development of the Ninth Five-Year Plan. If there is too little development in the Eighth Five-Year Plan it may be difficult to rely on the Ninth Five-Year Plan to make the leap. We must consider not only the objective for the year 2000 but also the levels of development in the years 1990 and 1995.

In order to meet the new high tide of economic development in the 1990's, there must be a larger increase in hydropower in the Eighth Five-Year Plan. Therefore, we must quickly begin a number of large and medium-sized hydropower projects in the next 2 years and the period of the Seventh Five-Year Plan. We should resolve to promptly put through some projects whose preliminary designs have been completed or for which substantial preparation have been made. For example, the construction period from the beginning to power generation is 8 years for hydropower projects at Wuqiangxi in Hunan which has been deliberated for many years (after two reductions in the storage level, losses from flooding have been reduced to 44,000 mu [inundated] and 85,700 people [displaced]; its installed capacity is 1.2 million kilowatts and it has the benefits of flood control and shipping), and Shuikou in Fujian (1.4 million kilowatts). They only have 5 and 7 generating units respectively which can be installed in 2 to 3 years. In other words, the entire construction period is 10 to 11 years. If construction could begin in 1985 they may be able to begin power generation in 1993, but if we continue to hesitate and delay, we fear that they will not begin production until the Ninth Five-Year Plan. Other large hydropower projects such as Lijiaxia (1.6 million kilowatts) and Heishanxia (Xiaoguangyin or Daliushu, 1.6 million kilowatts) on the Lower Huang He, the Tianshengqiao high dam (1.08 million kilowatts) on the Nanpan Jiang, Manwan in Yunnan (1 million kilowatts), Baozhusi (640,000 kilowatts) in Sichuan, Tankeng (600,000 kilowatts) in Zhejiang, Pankou (500,000 kilowatts) in Hubei, Mianhuatan (500,000 kilowatts) in Fujian, the Songjiang He cascade (440,000

kilowatts) in the northeast, Daxia (300,000 kilowatts) in Gansu and Xunyang (300,000 kilowatts) in Shaanxi have the conditions for construction which must begin as early as possible during the period of the Seventh Five-Year Plan. At the same time, we must build a number of medium-sized hydropower stations and continue to develop small ones. In this way, depending on when construction is arranged to begin for large hydropower stations and on the scale of development of medium-sized and small stations, it is possible to increase hydropower by 14 million to 17 million kilowatts during the period of the Eighth Five-Year Plan with a corresponding annual average growth rate of 6.5 to 7.7 percent.

In order to make it possible for development in the latter part of the 1990's to be sustained and even faster, some extra large hydropower stations must a also begin construction during the period of the Seventh Five-Year Plan, and they include such projects as Ertan (3 million kilowatts) in Sichuan, Longtan (4 million to 6 million kilowatts) in Guangxi, and the world famous Three Gorges of the Chang Jiang (13 million kilowatts). Moreover, some large hydropower stations must strive to begin construction in the early period of the Eighth Five-Year Plan, including Goupitan (2 million kilowatts) in Guizhou, Xiaowan (3 million kilowatts) in Yunnan, Pubugou (2.8 million kilowatts) and Pengshui (1.2 million kilowatts) in Sichuan, Geheyan (1.2 million kilowatts) in Hubei, Datengxia (1.2 million kilowatts) in Guangxi, Gongboxia (1 million kilowatts) on the Upper Huang He, Wanjiazhai (750,000 kilowatts) on the Middle Huang He and Jiangya (300,000 kilowatts) Hunan. The time these large projects begin construction and the measures they adopt to shorten construction time will determine the scale of their production before the year 2000. At the same time, we should extend some original hydropower stations such as Danjiangkou, Huanglongtan, Fengtan, Zhelin, Xin'an Jiang, Hunanzhen and Xinfeng Jiang, build pumped-storage power stations at Shisanling in Beijing, Shenzhen in Guangdong and Tianhuangping in northern Zhejiang, and continue to develop medium-sized and small hydropower stations. Tentatively it is possible to attain the goals of development as discussed above by the year 2000.

In the tentative ideas of development discussed above, we will carry out key development of the "rich mining" river sections of the Upper Huang He, Hongshui He and the main streams and tributaries of the Middle and Upper Chang Jiang. The Upper Huang He plan calls for 16 cascade power stations with future development of another 10 to 12. The Hongshui He plan call for 10 cascade power stations with future development of 7 to 8 more. The main stream of the Chang Jiang and the tributaries of the Middle Chang Jiang such as the Qing Jiang, Li Shui, Lou Shui, Yuan Shui, You Shui, Zi Shui, Lei Shui, Han Jiang, Du He, Gan Jiang and other cascades as well as the tributaries of the Upper Chang Jiang such as the Wu Jiang, Bailong Jiang, Upper Min Jiang, Dadu He, Nanya He, and Yalong Jiang will be developed one after another.

In developing rivers we must stress building hydropower stations with relatively large reservoirs in order to regulate run-of-river flooding and drying, utilize hydropower resources, and better suit the demand for power use. For instance, Longyangxia on the Upper Huang He, Longtan and the Tianshengqiao high dam on the Upper Hongshui He, Xiaowan on the Lancang Jiang, Ertan on the Yalong Jiang, Pubugou on the Dadu He, Yele on the Nanya

He, Baozhusi on the Bailong Jiang, Goupitan on the Wu Jiang, Hongjiadu on the Liuchong He, Shiti on the Upper You Shui and the Linxi He of the Upper Lou Shui all have relatively large reservoirs. We must develop them as early as possible and then build run-of-river hydropower stations downstream and improve the results of power generation.

Apart from meeting the needs of development in local areas, hydropower construction in western regions should combine with the characteristic that there are more hydropower resources in the west than the east and give the following main considerations of power transmission from west to east; from central to eastern China, from Guizhou and Guangxi to Guangdong, regulated use of hydropower and thermal power in the northwestern and northern China, and from the Wu Jiang to Hunan. Moreover, we should link up southern China with central China, the northwest and southwest with central China for hydrological and reservoir compensatory regulation.

Although there are less hydropower resources in eastern China, the northeast and northern China, economically they are more developed regions which have considerable power needs and there is increasing urgency in the demand on the power system for peak regulation. Consequently we should actively develop the Ou Jiang and Feiyun Jiang in Zhejiang, the Min Jiang and Ting Jiang in Fujian, the Upper Songhua Jiang and Mudan Jiang in the northeast, the Middle Huang He in northern China and other medium-sized hydropower stations. Supplying power to nearby areas is always better than shipping coal and transmitting power over long distances. Moreover, it is possible to give play to the strong point of hydropower being most convenient for peak and frequency modulation as well as emergency use in the power system. At the same time, we should expand the installed capacity of original hydropower stations which have reservoir regulation and the construction of some large pumped-storage power stations has been placed on the agenda.

We should also suitably arrange for medium-sized and small hydropower stations in outlying regions such as Xinjiang, Tibet, and Hainan Island. Xinjiang should develop the middle course of the Ili-Kax He. Xizang should develop the 800-meter high-head power station of the Yamzho Yumco Lake near Lhasa and Hainan Island should develop the Changhua Jiang.

For the demands on continued development of hydropower after the year 2000, before that time we still need to begin constructing a large number of hydropower stations such as the Xiangjiaba (4.64 million kilowatts), Xiluodu (9.68 million kilowatts), and Hutiaoxia (5.28 million kilowatts) on the Jinsha Jiang, Jinping (two cascades of 3 million kilowatts each) on the Yalong Jiang, Dusong (1.76 kilowatts) and Dagangshan (1.5 million kilowatts) on the Dadu He, Miaojiaba (1.2 million kilowatts) on the Bailong Jiang, Sijiacun (2.8 million kilowatts) on the Lancang Jiang, and Laxiwa on the upper course of the Huang He and give further consideration to west-to-east power transmission.

III. Key To Realizing Development Goals

1. Policies

(1) We must resolve to implement the guiding principle of the Party Central Committee and the State Council on the key development of hydropower. General Secretary Hu Yaobang dedicated these words when inspecting the Baishan hydropower station: "China's hydropower ranks first in the world, the power industry takes the lead in the four modernizations." In his government work report to the Fourth Session of the 5th NPC, Premier Zhao pointed out that "in the production and construction of electric power, we must develop thermal power and hydropower by suiting measures to local conditions, gradually shifting the emphasis to hydropower. Rural areas which have hydropower resources should develop small hydropower stations in order to solve the problem of energy shortage, reduce environmental pollution and lower power generation cost."

In order to "suit measures to local conditions", we should develop primarily hydropower and secondarily thermal power in the southwest and central-south (excluding Henan Province) as well as Qinghai, Gansu, Ningxia and other regions along the Upper Huang He where hydropower resources are most abundant. In order to "gradually put the emphasis on hydropower" we should gradually increase the proportion of hydropower in the power industry and should implement this guiding principle in planning and arrangement, allocation of investment and distribution of work.

(2) We must use large hydropower stations as the backbone. The construction time for large hydropower stations is long and we must do a good job in preconstruction work and begin construction ahead of schedule in order to promptly satisfy the needs of power use. Medium-sized hydropower stations require less investment and yield quick results. We must encourage local authorities and enterprises to raise funds or make joint investment on construction with the central authorities and benefits from the power stations should be divided according to the proportions of investment. Power stations built from locally raised funds should be managed locally. Their relationship with power grids can be centrally managed and electricity should be bought and sold according to contracts. The state should guarantee that it will not use any means to equalize and transfer resources indiscriminately or collect for itself. Rural areas must actively develop small hydrpower projects, carry out the guiding principle of "self-construction, self-management, and self-use," gradually improve economic results and promote rural electrification.

(3) We must do a good job in the overall planning of river development. When drawing up plans we must heed the opinions of concerned departments and the localities, implement technical democracy, conduct extensive discussions and study and select the best programs of development. We must implement the principle of comprehensive utilization. Apart from the use of hydropower for electric generation we should consider the benefits of comprehensive utilization such as flood control, irrigation, water supply, shipping, transport of logs, aquatic products, and tourism. We should also pay attention to environmental protection and ecological effects in order

to get the most social and economic results. We should demonstrate the economic rationality of the results which various departments demand and implement shared investment.

(4) We must do a good job in the long-term planning of the procedures for rational development based on the forecast for power needs. Once development procedures and construction projects are determined we should not make rash changes in order to avoid unnecessary losses. We must stress preconstruction work, earnestly do a good job in survey, scientific research, feasibility study, and preliminary design, and reserve more information for the selection of the best programs. In hydropower construction we must be resolute in handling matters according to capital construction procedures and begin construction only after preliminary design has been approved.

(5) We must do a good job in planning to arrange for the resettlement of people from reservoir areas, and implement the principle that after relocation their production and living standards will not be lowered and provide conditions for growth. The standards relating to resettlement expenses, land requisition, and other compensation should follow the "Measures for Land Requisition" issued by the State Council and the related regulations drawn up by the Ministry of Water Resources and Electric Power. To meet resettlement and land requisition expenses we must use special funds earmarked for this specific purpose only, and truly use it for the production and livelihood of those displaced and not divert it to other purposes. We may consider paying for some of the resettlement expenses out of the revenue from electric power after the hydropower station begins power generation. We can pay 1 or several percentage points based on kilowatt-hours and continue the payment for 10 years in order to reduce the initial resettlement expenses and win the support of those displaced for hydropower construction.

(6) We must combine with the arrangement of the state system of price regulation and consider the effects of price regulation of electricity and coal on the economic benefits of hydropower. At present, the domestic price of coal is too low and does not favor a correct appraisal of hydropower. We must readjust the price of peak charge so that it is higher than that of base charge before we can reflect the role of the capacity of peak modulation of hydropower or the price of peak modulation of thermal power generating units. The price of electricity of seasonal electric energy must be lower than that throughout the year in order to attract industries with high power consumption to use seasonal electric energy to develop production.

(7) Trans-provincial and trans-regional hydropower stations and reservoirs must draw up a rational policy to distribute benefits. The tax ratio or retained profits in the region where a hydropower station and reservoir are located should be divided according to the amount of hydropower resources tapped or the amount of flooding and losses in the local province or region as well as the contribution made toward the hydropower station at the time of its construction.

2. System reform

(1) We must gradually practice the system of economic responsibility for contracts among hydropower construction units which will arouse and give play to the enthusiasm of the broad masses of staff and workers.

(2) In survey work we must change the method of using drilling footage and other survey work volume as standards of accounting. We must draw up contracts with the goal of understanding engineering and geological conditions according to design requirements.

(3) In design work we must change the method of allocating design charges according to the number of people and collect design charges according to a definite ratio in the accounting of projects. Moreover, we should draw up concrete standards for charges for hydropower engineering design on the basis of the "Standards for Engineering Design Charges" issued by the State Planning Commission. We should gradually implement the method of bid invitation and bidding.

(4) We must carry out the system of responsibility of investment contracts and the contract system of bid invitation and bidding, change the method of monopolistic contracts and encourage competition. We must formulate policies to encourage the shortening of construction time, economize on investment, begin production ahead of schedule, and attain design capability. The funds saved from power generation and construction ahead of schedule will belong to the contract units, and funds borrowed on account of delay in work schedules will be their responsibility.

(5) Science and technology must be geared to economic construction while economic construction must rely on science and technology. Development and application research should adopt the system of compensatory contracts and basic research should adopt the scientific fund system.

(6) We must improve the treatment of survey, construction and other field workers and give preferential subsidies according to different conditions. Survey field workers should enjoy the same treatment as geological survey workers in the same work type.

3. Sources of funds

(1) We hope that under the prerequisite that with emphasis given to energy as well as communications and transportation in the overall planning and arrangement by the state, hydropower development will be treated as a key construction item in order to ease the pressure on coal supply and transportation. Considering the characteristic of hydropower in its simultaneous completion of primary energy development and secondary energy conversion, special investment should be made on hydropower. The construction time of hydropower is relatively long. Large stations must begin construction during the period of the Seventh Five-Year Plan in order to play their role in the period of the new economic revitalization in the 1990's. We must increase the "fore strength" in order to give play to the "reserve strength."

Therefore, the arrangement of the Seventh Five-Year Plan is the key to whether hydropower can develop successfully. We hope that when the state arranges the Seventh Five-Year Plan hydropower will be ranked among the key areas.

(2) We must actively utilize foreign capital or issue hydropower bonds at home and abroad. According to the experience abroad, hydropower bonds or stocks are most reliable and popular.

(3) Mobilize local authorities and enterprises to raise funds for the construction of medium-sized hydropower stations. From the standpoint of hydropower construction, it is best for investment in medium-sized hydropower stations to come from local authorities, otherwise these authorities should be permitted to issue stocks to absorb the investment potential of local enterprises, residents, and overseas Chinese in cities and the countryside. Hydropower stations on the Upper Huang He can be developed in cooperation with the Bureau of Nonferrous Metals and joint management of aluminum and power can be carried out; Manwan in Yunnan can cooperate with chemical industrial departments to jointly manage phosphorous and power.

(4) We must do a good job in the "second chapter" in accordance to General Secretary Hu Yaobang's instructions, namely, "we must lower construction cost, select the best programs, and shorten construction time." There is great potential in this respects. In the 1940's and early 1960's the several dozen large hydropower stations of several hundred thousand kilowatts which we built took a construction time of 3 to 4 years before power generation, the investment per kilowatt was about half of what it is today. Although the conditions of hydropower stations built in the early period were good and there were more difficulties later, there are still a considerable potential that can be tapped. By solving the problem of "eating out of a big pot" through system reform, giving full play to the enthusiasm of the broad masses of technical cadres and staff workers, relying on science and technology, and adopting advanced technology, we are sure to be able to lower construction cost, shorten construction time, and improve economic results. By striving to build three power stations for the cost of two, or building four for the cost of three, the total investment will be equivalent to an increase by one-third or one-fourth.

4. Rely on scientific and technical progress

Hydropower stations to be constructed in the future will be of large scale. There are more than 10 large stations of 1 million kilowatts or more. The height of dams must be increased from the 100-odd meters of those already built to over 200 meters. The requirements of flood discharge facilities of high-discharge high-head are increasingly high. The geological conditions of some dam sites are quite complex and require different measures of foundation treatment. Therefore, new technical breakthroughs are needed in survey, design, scientific research and construction.

(1) In survey methods, we need to adopt remote sensing, physical exploration and other advanced techniques to coordinate with drilling and tunnel exploration and we must improve the capability of hydraulic geology to judge and analyze.

(2) We must adopt advanced technology in design. We must select the dam type by suiting measures to local conditions and preferentially use earth-rock dams or light dams in places where conditions are suitable. Moreover, we must adopt various measures to reduce the amount of engineering and economize on the three materials.

(3) We must strengthen scientific research work, study and popularize new techniques, new materials, new technology and new equipment and continually improve technical proficiency. Design and construction standards must be revised along with technical progress.

(4) We must import advanced technology and hire highly-experienced specialists or organize consultative groups from around the world for consultation on certain key technical issues. We have previously done this for such large projects as Longyangxia, Ertan, Longtan and Sanxia, and we can contintue to strengthen this in the future.

(5) The quality and efficiency of hydroelectric generating units must be improved and considerable result in power generation can be improved under similar conditions. We should also adopt the system of bid invitation for the supply of generating units.

(6) In planning, design, scientific research and construction as well as the use of hydropower stations, we should make heavy use of system engineering and electronic computers to increase the speed of work and improve quality and efficiency.

(7) Qualified personnel are a key issue in completing the glorious task of hydropower development by the year 2000. We must estimate the various specialized personnel needed including technical cadres, technical workers, and administrative cadres, and we must train them early. We also need to train and rotationally train staff and workers who are on the job. We must stress knowledge and technology and earnestly implement the policy toward intellectuals.

(8) We believe that after adopting the various measures discussed above, the new situation for hydropower construction in China will arise and the strategic goal for the year 2000 is certainly attainable.

9586
CSO: 4103/34

HYDROPOWER

SMALL-SCALE HYDROPOWER'S GROWING ROLE IN RURAL POWER SUPPLY

Beijing SHUILI SHUIDIAN JISHU [WATER RESOURCES AND HYDROPOWER ENGINEERING] in Chinese No 11, 20 Nov 84 p 62

[Excerpts] From January to September 1984, 798 new small-scale hydropower stations were completed throughout the nation; with some 259,400 kilowatts in newly installed capacity. This represents a 33.3 percent increase over the same period in 1983. Guangdong Province alone added 50,000 kilowatts in installed capacity, Fujian Province 35,000 kilowatts, while Zhejiang, Hunan, Sichuan, and Yunnan Provinces added more than 20,000 kilowatts. It is estimated that nationally, 500,000 kilowatts in installed capacity could be completed in 1984.

From January to September of this year, the nation's small-scale hydropower stations generated 15.3 billion kilowatt-hours of electricity, 790 million kWh more than the same period in 1983, for an increase of 5.45 percent. Estimates for the entire year run to 22 billion kilowatt-hours.

As of the end of September, the nation had completed more than 77,000 small-scale hydropower stations with a total installed capacity of 8.76 million kilowatts, more than 4 times the total installed capacity in 1949 for all stations in the country--large, medium, and small. In 1983, small-scale hydropower generated 20 billion kilowatt-hours, representing one-third of the electricity consumed by agriculture. In Guangdong Province, installed capacity for small-scale hydropower is 1.367 million kilowatts; Sichuan and Hunan Provinces have in excess of 850,000 kilowatts, and Fujian, Guangxi, Zhejiang, Yunnan, Hubei, and Jiangxi have more than 500,000 kilowatts. Two hundred seventy counties have more than 10,000 kilowatts, and more than 40 have more than 20,000 kilowatts. Ranking first in the country is Longmen County in Guangdong Province, with an installed capacity of 36,000 kilowatts.

Today, small-scale hydropower is a major source of electricity for agriculture in China and nationally, 1,574 counties manage such [stations], with 770 of these counties, or one-third of all the counties in the country, depending on small-scale hydropower as their principal source of electricity. Some 20,000 townships receive electricity from small-scale hydropower, 40 percent of the total number of townships in the country. Single-unit capacity for small-scale hydropower stations has grown from several tens of kilowatts to more than 10,000. Multiple stations and grid integration has

now replaced the individual station and dispersed power supply; whereas previously small-scale hydropower provided electricity for lighting in mountainous regions, today county-run industries are powered by this source. Many county enterprises now have their own independent small-scale power grids. Some 520,000 kilometers of high-tension power transmission lines and 1.1 million kilometers of low-tension lines have now been erected to handle small-scale hydropower production, for a total capacity of nearly 42 million kVA.

CSO: 4013/82

HYDROPOWER

OFFICIALS VISIT DONGJIANG SITE, URGE COMPLETION BY 1987

HK151324 Changsha Hunan Provincial Service in Mandarin 0000 GMT 15 Jan 85

[Text] According to HUNAN RIBAO, from 10 to 12 January Mao Zhiyong, first secretary of the Hunan Provincial CPC Committee; Liu Zheng, provincial governor; (Chen Bangzhu), provincial vice governor; (Shi Jie), adviser to the provincial government; responsible comrades of the organs directly under the provincial authorities and the prefectural, city, and county leaders in Chenzhou and Hengyang prefectures went to the (Leiyang) construction site of the Dongjiang hydropower station, a key project in the province, to extend their regards to those laborers who have fought at the site for many years.

The leading comrades of the provincial CPC committee inspected the construction progress of the two projects and studied the difficulties and problems in the construction. Some problems were resolved instantly.

Comrade Mao Zhiyong said that only by rapidly developing energy, electric power supplies in particular, will it be possible for Hunan to achieve the target of quadrupling output. The province suffers a shortage of 2 billion kilowatt-hours in annual power supply. If this problem can properly be resolved, the province can increase its annual output value by 3 billion yuan and profit tax by 600 million yuan even if there is no growth in the labor force and equipment.

Comrade Liu Zheng also expressed the hope that the Dongjiang hydropower station, on the premise of ensuring quality, will accelerate the progress of construction, ensure an accident-free flood season, and, on the basis of fulfilling the original task of pouring 420,000 cubic meters of concrete, pour 100,000 cubic meters more of concrete. He also demanded that the hydropower station do its best to generate electricity before the first quarter of 1987.

He also announced that in order to satisfy the above two demands, the provincial CPC committee and government have decided to give the staff members and workers of the hydropower station rewards amounting to 1 or 2 months of their salaries.

CSO: 4013/74

HYDROPOWER

SUPPLY PROBLEMS DELAY GEZHOUBA PROJECT

HK290414 Beijing CHINA DAILY in English 29 Dec 84 p 1

[Article by staff reporter Chang Jiang]

[Text] The State Bureau of Goods and Materials is working hard to try to overcome a supply problem that is holding up work on a major hydroelectric project.

Earlier this week it was reported that the Gezhouba project on the Chang Jiang was awaiting delivery of 8,000 tons of reinforced steel bars. The delay could result in postponement for at least a year of part of the project which would mean a loss of about 100 million yuan to the state.

To meet the emergency, the bureau has sent 3,300 tons of reinforcing steel bars to the construction site, a bureau official told CHINA DAILY yesterday.

She said the bureau is making every effort to solve the problem, and she believed the rest will be available soon.

"We have applied for permission to the State Planning Committee to use some state reserves, and the Ministry of Metallurgy is asking steel plants to produce extra bars," she said.

"In any case, we will help the project to go ahead as scheduled," she said.

The shortage is the result of speed in other parts of the project. By the end of this month, 1.8 million cubic meters of reinforced concrete will have poured into the river to form a cornerstone of the construction, though the state plan initially called for only 1.45 million cubic meters.

CSO: 4010/63

HYDROPOWER

CHANG JIANG GORGES PROJECT STUDY COMPLETED

OW180950 Beijing XINHUA in English 0929 GMT 18 Jan 85

[Text] Wuhan, 18 Jan (XINHUA)--Feasibility studies have been completed for the gigantic Chang Jiang gorges hydroengineering project, it was reported here today.

Scientists from all over the country have conducted nearly 30 years of extensive experiments, according to the Wuhan-based Chang Jiang River Basin Planning Office in charge of the scheme.

The three gorges--Qutang, Wu, and Xiling gorges between Fengjie in Sichuan Province and Yichang in Hubei Province--are 193 kilometers long. They are noted for turbulent waters and precipitous peaks.

Scientists now believe that this section of the Chang Jiang is ideal for hydroelectric power generation.

Scientists have proposed that Sandouping, 40 kilometers upstream in Yichang, be selected as the site for the project. Thirty-five kilometers of banks there are composed of granite, suitable for the construction of a high dam, a planning office official said.

No destructive earthquake has ever occurred in the area, he said, noting that the conclusion was based on 20 years of observations and 2,000 years of historical records.

According to hydrological data, he said, there had been only eight floods larger than 80,000 cubic meters per second along the Yichang section since 1153. The biggest, in 1870, reached 110,000 cubic meters per second.

He said that this provided reliable data for the required design of the project's flood discharging capacity.

CSO: 4010/63

HYDROPOWER

PREPARATORY WORK CONTINUES ON YUNNAN'S MANWAN PROJECT

HK250357 Kunming Yunnan Provincial Service in Mandarin 2300 GMT 24 Jan 85

[Excerpts] With state approval, the Manwan power station, the first large hydroelectric station on the Lancang Jiang in Yunnan, is to be constructed. The Ministry of Water Resources and Electric Power and Yunnan Province will together provide the investment for the plant, which will eventually have six generator sets with a total capacity of 1.5 million kilowatts, able to generate over 7 billion kWh a year. It is estimated that the first generator set can go into operation 7 years after construction begins on the main body of the station. When the whole project is completed, around the year 2000, it will become the main power station in Yunnan and play an important role in economic construction.

The dam of the power station will be the first one for exploiting the Lancang Jiang and will also be the first on the five main water courses in the province. The Ministry of Water Resources and Electric Power and the Yunnan Provincial Government are attaching extremely great importance to this project and are carefully organizing and leading the preparatory work. The provincial departments and units concerned and Licang, Simao, and Dali prefectures are providing vigorous support for the construction.

CSO: 4013/81

HYDROPOWER

BIDDING OPENS ON MATERIAL, EQUIPMENT FOR LUBUGE PROJECT

Kunming YUNNAN RIBAO in Chinese 11 Jan 85 p 1

[Text] Beijing, 9 Jan 85, XINHUA -- Bids were opened here today on the first batch of construction equipment and steel materials for the Lubuge hydroelectric power station which is located on the border between Yunnan and Guizhou provinces.

Bids were submitted by Japan, the United States, Sweden, Finland, Italy, the Federal Republic of Germany, Yugoslavia, China, and Hong Kong.

Items being bid on included dump trucks, heavy trucks, earth and rock excavation machinery, and 30,000 tons of steel materials for a total value of approximately 21 million dollars.

Work on the Lubuge hydropower station, with a yearly design output of 2.75 billion kilowatt-hours, officially got under way in 1984 and plans call for its completion in 1989.

The World Bank has extended a loan on this project for the sum of U.S. $145.4 million. It was for the construction items under this loan that international bids were solicited. For the earthwork project, Japan's Taisei Construction Company beat out eight other construction companies in 1984 to win the contract for the 9.4-kilometer-long water diversion tunnel.

International bidding companies under the China Technical Import Corporation will continue to conduct bidding on construction equipment and engineering materials that will be needed by the Lubuge hydroelectric power station construction project, including dump trucks, measuring instruments and meters, power lines, etc.

CSO: 4013/93

HYDROPOWER

WORK BEGINS ON MAIN PROJECT OF TONGJIEZI

OW231657 Beijing XINHUA in English 1647 GMT 23 Jan 85

[Text] Chengdu, 23 January (XINHUA)--Work started today on the main project of a large hydroelectric power station on the Dadu He in Sichuan Province.

Located in Leshan City, the Tongjiezi station will have a capacity of 600,000kW and generate 3.2 billion kWh of electricity a year, equivalent to 20 percent of the provinces present output.

As one of the states key projects, the station which will also have the secondary functions of assisting log rafting, irrigation, and navigation on the river, will be completed in 1993.

The station will be second on the Dadu He, following the 700,000-kW Gongzui station which was built in 1977.

CSO: 4013/81

THERMAL POWER

BRIEFS

TAIZHOU UPDATE--The Taizhou power plant has accelerated the construction of its second phase, involving the No. 3 125,000-kilowatt generator, in an all-out effort to shave 5 months off the State Plan and have the unit tied into the grid by June 1985. Today, Zhejiang's tallest stack (210 meters) is almost finished, as is the power house for the No. 3 generator; work on the structure and equipment for the No. 4 generator is being stepped up. [Text] [Hangzhou ZHEJIANG RIBAO in Chinese 3 Jan 85 p 1]

CSO: 4013/90

COAL

ANHUI LOCAL MINES GROW DRAMATICALLY

OW112030 Hefei Anhui Provincial Service in Mandarin 1100 GMT 8 Jan 85

[Excerpts] The Anhui Provincial Department of Coal Industry held a meeting in Hefei on 8 January to commend advanced units and collectives in the province's coal industry. The meeting commended representatives of the advanced units, collectives, and individuals from local coal mines that achieved good results last year.

Those who attended the meeting to extend their congratulations included provincial party and government responsible comrades Huang Huang, Wang Yuzhao, Shi Junjie, Lu Rongjiang, and Chai Dengbang; and veteran comrades who have contributed to the development of our province's coal industry and are now retired to the second line. Governor Wang Yuzhao spoke at the meeting.

Last year, the provincial party committee and government, considering the increasing demand for coal by the province's industry and agriculture, decided to speed up development of local coal mines. They have set the output targets of local coal mines for 1984, 1990, and 2000 at 3 million tons, 5 million tons, and 10 million tons respectively.

Abiding by the provincial party committee's instruction, the Provincial Department of Coal Industry has paid attention to technical transformation of old coal mines on the one hand and to the building of coal mines run by towns and villages on the other.

By the end of last year, the number of small coal mines in the provinces had increased to more than 900 from some 400 at the beginning of that year, with their coal output increasing by 80 percent in the same period. As a result, a number of advanced units, collectives, and individuals have come to the fore.

The more than 300 representatives present at the meeting were high-spirited and were determined to tap coal resources at a faster rate as well as to build new coal mines, produce more coal at lower costs, and strive to fulfill this year's goal of producing 4 million tons of coal by local coal mines and make new contributions to our province's economic takeoff.

CSO: 4013/74

COAL

FOREIGN BANKS EYE SHANXI GASIFICATION PROJECT

OW210830 Beijing XINHUA in English 0652 GMT 21 Dec 84

[Text] Beijing, 21 Dec (XINHUA)--Bankers and industrialists from several foreign countries are attending a fundraising meeting for a project to make gas from coal produced in Shanxi Province.

Participants were reported to be interested in the Taiyuan coal gasification company set up in 1981 by the Shanxi provincial government and the Ministry of Coal Industry.

The meeting, which began yesterday, aims at attracting foreign investment made in the forms of joint venture, compensation trade or loans, an organizing official said.

Participants at the meeting are from Japan, Italy, Britain, the FRG, the United States, Austria, and France.

Shanxi produces nearly one-fourth of the country's coal. It is the center of a major energy and coal/chemical industrial base planned for north China.

Gasification is also expected to ease the tension on outgoing transport of Shanxi coal by rail, which has bottlenecked the province's coal production.

CSO: 4010/63

COAL

NINGXIA EXCAVATES RECORD TONNAGE IN 1984

OW240800 Beijing XINHUA in English 0643 GMT 24 Jan 85

[Text] Yinchuan, 24 January (XINHUA)--The Ningxia Hui Autonomous Region, a rising coal center in northwest China, excavated a record 10.62 million tons of coal in 1984, according to the local authorities.

The region has so far put more than 50 mines into operation, 10 of them cutting more than 1 million tons each annually.

Another mine with an annual output of 210,000 tons is under construction at the Lingwu coalfield and mining equipment is being updated in three old coalfields, which is expected to help double the present output of 8 million tons by the end of the century.

Ningxia has a verified coal reserve of 28.9 billion tons, ranking fifth in China.

The Taixi anthracite produced at the Rujigou coalfield has low dust, sulphur, and phosphorus contents, and is exported to 11 countries, including Belgium, Britain, France and Luxembourg.

Since the region was founded in 1958, a total of 150 million tons of coal have been produced.

In addition, Ningxia has built a coal dressing plant with an annual capacity of 3 million tons, and a number of backup machinery, cement, chemical and building material plants.

Now the region is boosting coal-consuming industries by building more thermal power and fertilizer plants.

CSO: 4010/64

COAL

NEW RAIL LINES BOOST SHIPMENTS FROM SHANXI

OW221229 Beijing XINHUA in English 1150 GMT 22 Jan 85

[Text] Taiyuan, 22 January (XINHUA)--In 1984 more than 123 million tons of coal were shipped from Shanxi Province, China's leading coal producer, some 20 million tons more than the planned figure, according to local officials.

Of this amount, 108 million tons were carried by railways.

The officials said the province cut 177 million tons of coal last year, about 24 percent of the nation's annual output.

China has over the past few years concentrated its efforts on improving railways and roads in Shanxi Province to other parts of the country as shipping more coal out of Shanxi will have a great bearing on the country's economic growth, especially in some energy-short regions in east China and southern part of northeast China.

In the past few years, the country has invested heavily in upgrading seven railway lines to boost the coal shipment from Shanxi to 150 million tons by 1987 as against 95 million tons in 1983.

The railway lines include China's first special double-track electrified railway. Starting from the Datong coal mining administration, the largest of more than 80 in the country, it will terminate at the port of Qinhuangdao in Hebei Province. The 630-kilometer railway is designed for trains of between 6,000 and 10,000 tons. After its completion in 1987, it will handle 100 million tons of Shanxi coal.

Shanxi's roads and railways will have a total carrying capacity of more than 400 million tons of coal by the year 1990.

CSO: 4010/64

COAL

BRIEFS

SHUOLI MINES EXCEED QUOTA--Since the beginning of the 4th quarter, the Shuoli mines have consistently exceeded the quotas for raw coal production. Since the beginning of the year, these mines have concentrated on both enterprise reorganization and technical renovation, creating a very favorable production situation. Up to September, the production of raw coal had exceeded 1.13 million tons, exceeding the plan by 6.8 percent; tunnel footage exceeded the plan by 7.4 percent, while other quotas were all fulfilled satisfactorily. Resolved to produce an additional 370,000 tons before the end of the year, total output will be 1.5 million tons, setting an all-time record for the mines. [Excerpts] [Hefei ANHUI RIBAO in Chinese 25 Nov 84 p 1]

SHAANXI 1984 PRODUCTION--Shaanxi Province's coal mines have fulfilled the annual plan for both raw coal produced and footage drilled. Unified distribution mines completed the entire 1984 plan 18 days early and exceeded the raw coal quota by some 33,000 tons. This is an increase of 4.9 percent over the same period in 1983. Footage exceeded the 1984 plan by 35 meters and was completed 21 days early. Raw coal production by local coal mines beat the plan by 850,000 tons and quotas were met 36 days ahead of schedule. [Xi'an SHAANXI RIBAO in Chinese 25 Dec 84 p 1] /Text/

SHANXI'S PEASANT-RUN MINES--Taiyuan, 14 Jan (XINHUA)--Peasants of Shanxi Province last year opened 699 new coal pits which had an annual production capacity of over 39.9 million tons, according to the provincial coal resources committee. This was 10 million tons higher than the annual output of the Datong mining administration, China's biggest coal producer. The coal is deposited in shallow geological formations and easily exploitable in the province, said the committee. The committee made an investigation in 50 counties and allocated to peasants pits with a coal reserve of 15 billion tons. [Excerpts] [Beijing XINHUA in English 1045 GMT 14 Jan 85]

NEW GUIZHOU MINE--Guiyang, 27 Dec (XINHUA)--A coal mine designed to produce 1.2 million tons a year went into operation today in a major coal field in Guizhou Province. This brings the annual production capacity of Liupanshui coal field to over 10 million tons. The Tucheng mine will help alleviate the coal shortage in southern China, officials here said. [Text] [Beijing XINHUA in English 1646 GMT 27 Dec 84 OW]

NEW TIEFA MINE--Shenyang, 15 Dec (XINHUA)--A coal mine designed to produce 1.2 million tons a year went into operation today in a major coal field in Liaoning Province. The 513-square-kilometer Tiefa coal field is a national key energy project, where reserves are verified at 2.25 billion tons. It supplies the nearby Qinghe thermal electric power plant, China's largest. Five mines--including Xiaoqing mine which went into operation today--have been built at Tiefa. The mines have a combined annual production capacity of 5.4 million tons. Work on three more new mines is now underway. The coal field will eventually produce 15.4 million tons a year, officials here said. [Text] [Beijing XINHUA in English 1635 GMT 15 Dec 84 OW]

NATION'S RESERVES SET AT 780 BILLION TONS--Beijing, 22 January (XINHUA)--China verified new coal reserves of 10.2 billion tons in 1984, bringing its total to more than 780 billion tons, Guangming daily reported today. Over two-thirds of the deposits were found in major coal producing areas of Shanxi, Shandong, Hebei, and Henan Provinces. Reserves were also located in northeast China, the northern part of Anhui Province and eastern Inner Mongolia. China had produced 717.27 million tons of coal by 13 December up 9.5 percent over the same period in 1983. [Text] [Beijing XINHUA in English 0658 GMT 22 Jan 85 OW]

CSO: 4010/64

OIL AND GAS

MORE NATURAL GAS RESERVES FOUND IN SICHUAN

OW220848 Beijing XINHUA in English 0711 GMT 22 Dec 84

[Text] Chengdu, 22 Dec (XINHUA)--Gas reserves found in Sichuan so far this year amount to 10 billion cubic meters, according to official sources here.

Sichuan was the first Chinese province to explore and use natural gas, now found in areas of 180,000 square kilometers or about one-third of the province. It furnishes one-half of the nation's output.

The new gas reserves, in 15 enclosed structures, 6 gas-bearing structures and 14 reservoirs, strengthened the confidence of the authorities in the projected output target of 10 billion cubic meters for 1990, up from 5.46 billion cubic meters this year.

Bechtel of the United States is helping Sichuan in planning and seismic exploration. Drilling and extraction technologies from the Societe Nationale Elf-Aquitaine of France and Halliburton of the United States are being used in Sichuan's gas fields.

CSO: 4010/63

OIL AND GAS

SHENGLI INCREASES OUTPUT IN 1984

OW011628 Beijing XINHUA in English 1439 GMT 1 Jan 85

[Text] Jinan, 1 Jan (XINHUA)--The Shengli oilfield in east China, one of the country's major oilfields, produced 23 million tons of crude oil last year, 4.64 million tons more than in 1983.

The geological reserve of oil verified last year amounted to 1 billion tons, five times the 1983 figure.

The oilfield witnessed the biggest increases in oil production and reserve than any year in the 21 years since its inception.

The oilfield hit the eco-technical index as set in the state plan: 2.14 million meters of drilling footage, 86.5 percent up over 1983; a newly added crude oil production capacity of 3.3 million tons, 3.3 times the 1983 figure; total industrial output value of 2.59 billion yuan, 24.5 percent up; 1,046 billion yuan of taxes and profits turned over to the state, 20.3 percent up.

The daily output of crude oil last December averaged 74,879 tons, 21,000 tons more than in the same 1983 period; 666 new wells were put into operation for an increase of more than 4 million tons of crude oil last year.

CSO: 4010/63

OIL AND GAS

LARGE SCALE GAS PLANT TO BE BUILT IN HEILONGJIANG

SK241026 Harbin HEILONGJIANG RIBAO in Chinese 4 Jan 85 p 1

[Text] On 3 January, the Harbin City People's Government proclaimed that the project of building the biggest gas plant in the country next to a colliery, the Harbin Yilan gas plant, was recently approved by the State Council and listed with [other] key state project plans. After completing the building of the project, more than 80 percent of Harbin City's residents will be able to cook their food without coal.

The city gas plant project site is located at the Balianhezhen colliery in Yilan County. The plant will supply gas through pipeline systems. The entire project is divided into the following three parts:

1. A modern gas plant with a 1.2 million ton annual coal consumption and 1.6 million cubic meters of daily gas output will be built beside the colliery;

2. A pipeline system 250 kilometers in total length will be laid up between Yilan County and Harbin City through Fangzheng and Binxian Counties;

3. A Harbin City network of high- and medium-pressure pipelines over 120 kilometers in total length and 45 gas and pressure transforming stations will be built.

The entire project has been divided into the following two construction stages: The first-stage construction will begin in 1986 and will be finished in 1988 and the newly-built gas plant will have 600,000 cubic meters of daily gas output. Second-stage construction will begin in 1989 and will be finished in 1990 and the new plant will have 1.6 million cubic meters of total daily gas output.

After completing the project, Harbin City will enjoy a daily gas supply of 1.5 million cubic meters. In addition to providing gas for industrial use and public utilities, 450,000 households in the city will be supplied. The rate of gas consumption will reach 80 percent.

According to survey data, the deposit of the Yilan colliery will last for more than 100 years. The Harbin City People's Government has organized an administration department in charge of the construction with the mayor as its director and is mobilizing the people throughout the city to make contributions to the project and to strive to complete the preparatory work this year.

CSO: 4013/81

OIL AND GAS

GEOLOGICAL EVIDENCE SHOWS LIAODONGWAN TO BE PRIME PROSPECTING TARGET

Beijing SHIYOU KANTAN YU KAIFA [PETROLEUM EXPLORATION AND DEVELOPMENT] in Chinese Vol 11, No 5, 1984 pp 1-8

[Article by Tong Xiaoguang [4547 2556 0342]: "A Forecast of Prospects and Petroleum Geology in Liaodongwan Depression--Geological Analogy between Liaodongwan Depression and Liaohe Depression"]

[Text] Abstract

Liaodongwan depression and Liaohe depression are very similar in geological structure. In fact, they are located in a united geological unit, the only difference being one covered by seawater and the other located onshore. Therefore, characteristics of petroleum geology in these depressions should be similar.

Based on the petroleum geology of the highly developed Liaohe depression and seismic data of the Liaodongwan depression, the author analyzed the oil prospect and oil gas distribution of the Liaodongwan depression and concluded that it is one of the most potential regions for oil gas in the Bohaiwan basin.

On the northeastern corner of the Bohaiwan basin lie the ocean-covered Liaodongwan depression and the landlocked Liaohe depression both belonging to the same geological structural unit. The Liaohe depression has now become one of China's important oil gas bases, indicating the promising prospects of the Liaodongwan depression. In this article we shall explore the oil gas prospects of Liaodongwan based on the similarities and differences of the two depressions and the petroleum geology of the Liaohe depression.

I. Geological Similarities and Differences of the Liaodongwan and Liaohe Depressions

Both depressions evolved on the northern China plateau, they may be connected by an old land in the mid and late Proterozoic era, mid and early Proterozoic erathem sediments were found on both sides of the depression and Proleozoic erathem sediments were found throughout the area. From the Triassic period to the mid Jurrassic period, the area underwent violent bulging and denudation,

ancient bed rocks were exposed and structural cracks and weathering fissures were found. The extent of denudation of the Liaohe depression is greater than that of the Liaodongwan depression and the latter preserved a greater area of mid and early Proterozoic erathem sedimentary rocks and Proleozoic erathem sedimentary rocks. Under the influence of the rift running in the northeast direction, the area underwent differential block faulting activities in the late Jurassic epoch to the early Cretaceous epoch and produced a series of depressions filled with volcanic rocks and coal bearing argillo-arenaceous rocks. Based on seismic data, the upper Jurassic series and the lower Cretaceous series are estimated to be several thousand meters deep. After the lower Cretaceous sedimentation, there was another long period of rising and denudation and the Eocene series Kongdian formation, ubiquitous in other depressions in Bohaiwan basin, is not well developed in this region. From the late Eocene epoch to the Oligocene epoch, this area had violent block faulting and large rifts running north by northeast prevail. The three large rifts of the Liaodongwan depression are all longer than 100 km long, they actually belong to the same fault system. Many believe that this is part of the northward extension of the Tanlu rift and the author agrees. But judging from the available geological data, it is a tensile rift of the late Eocene epoch to the Oligocene epoch and has the characteristics of a continental rift valley. The fracture surfaces of the major rifts are tilted toward the west and cuts the bedrocks of the pretertiary system into strips of tilted fault blocks. The overlaying lower tertiary system are scoop-shaped depressions and the maximum thickness is about 6000 m. In the Shahejie formation, the major oil bearing stratum of the Bohaiwan basin, the two depressions are well developed and the average thickness of the Liaodongwan depression is slightly greater than that of the Liaohe depression, see Fig. 1.

In the northern part of the Liaodongwan depression the thickness of the Dongying formation is relatively small, in the southern part it is similar to that at Liaohe depression, see Fig. 2. The thickness of the upper tertiary system increases from north to south and from east and west to the center, as shown in Fig. 3. The thickness of the tertiary system of the Liaodongwan depression is greater than that of the Liaohe depression but much smaller than adjacent Bozhong depression to the south. The thickness is favorable for the development of the underlying oil bearing stratum of the tertiary system but not too deep for the access to the major target strata.

The sea advanced in the Quaternary period, covering Liaodonquan, Bohaiwan, and other regions. The farthest position was once at 40 km north of the coastline today. In the late Quaternary period the coastline moved south again. From a geological structural viewpoint, there is no clear boundary between the Liaodongwan depression and the Liaohe depression, the only difference is that one part of the same structure unit is covered by the sea.

The similarity between the two depressions also manifests in the correspondence between the secondary structural units in the two depressions, as shown in Fig. 4. The correspondences are given below:

Liaodongwan depression	Liaohe depression
1' Liaoxi indentation	1. Western indentation
2' Liaoxi boss	2. Central boss

3'	Liaozhong indentation	3.	Eastern indentation
4'	Liaodong boss	4.	Sanjiepao [0005 3954 3133] Sunken mountain zone
5'	Liaodong indentation	5.	Indentation on the east side of Sanjiepao

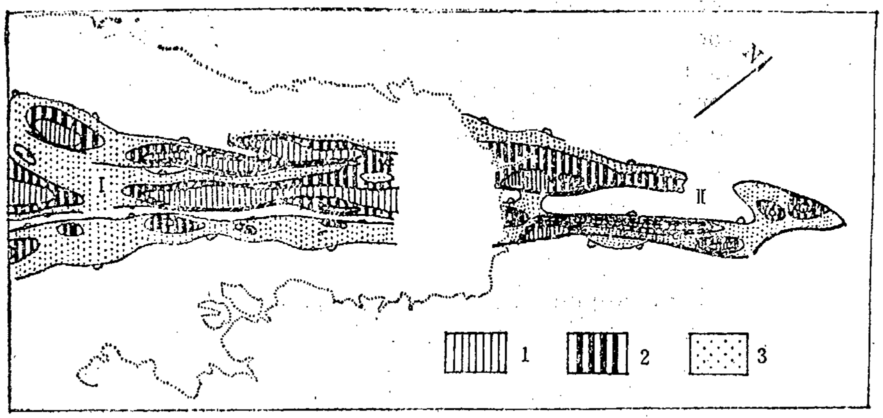

Figure 1. Isopach diagram of the Shahejie formation in the Lioadongwan depression and the Liaohe depression

1. Greater than 2000 m, 2. 1000-2000 m, 3. Less than 1000 m,
I. Laiodongwan depression, II. Liaohe depression

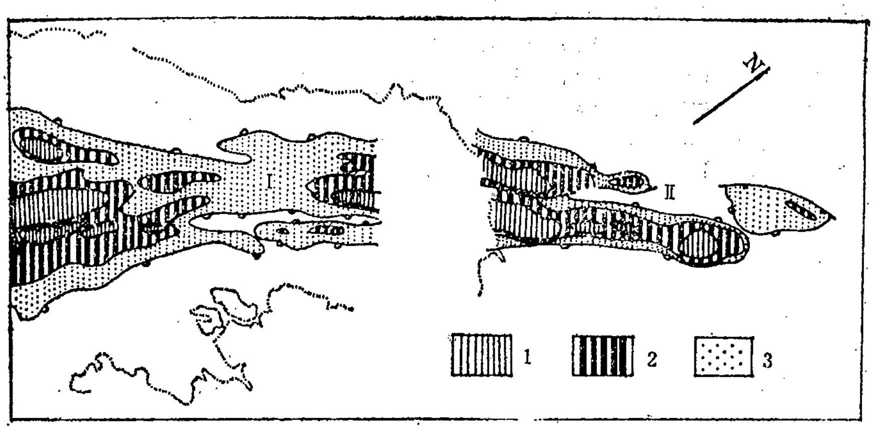

Figure 2. Isopach diagram of the Dongying formation in the Liaodongwan depression and the Liaohe depression

1. Greater than 1000, 2. 500-1000 m, 3. Less than 500 m

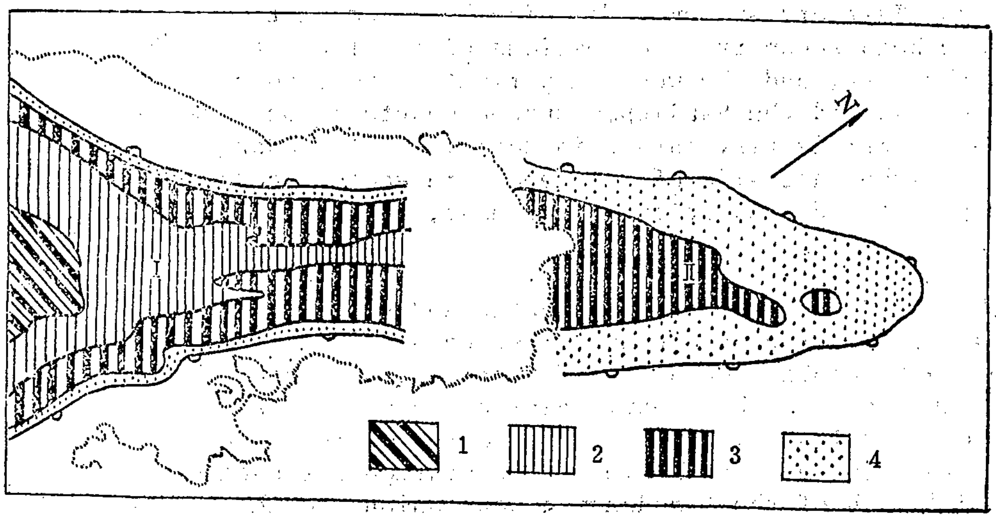

Figure 3. Isopach diagram of the upper Tertiary system of the Liaodongwan depression and the Liaohe depression

1. Greater than 2000 m, 2. 1000-2000 m, 3. 500-1000 m, 4. 0-500 m

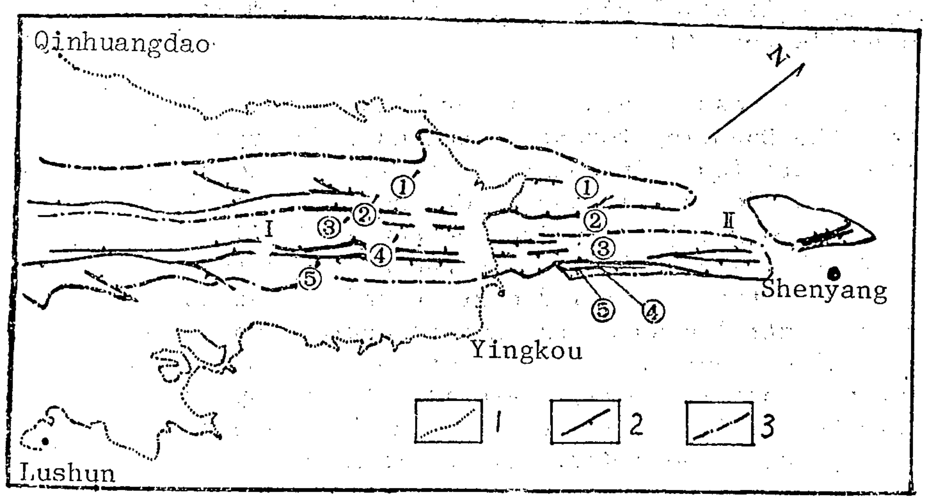

Figure 4. Structural diagram of Liaodongwan and Liaohe depressions

1. Coastline, 2. Major fault, 3. Boundary of structural units

All corresponding secondary structural units are connected and basically have the same regional and geological structures. Liaoxi indentation and the western indentation are typical scoop type depression. On the east side is a fundamental big fault, the bottom on the west side has an overlap, the top shows denudation and there exists alignment nonconformity between the upper Tertiary system and the lower Tertiary system. Both the Liaoxi boss and the central boss are high on the west and low on the east and the east side is

covered by the Tertiary system. The Liaozhong indentation and the eastern indentation are both scoop type depressions with a fault to the east and an overlap to the west, and the western perimeter shows no obvious nonconformity. The Liaodong boss and the Sanjiepao sunken mountain zone are both horst type boss but the former is very larger in scale. The Liaodong indentation and the indentation on the east side of Sanjiepao are scoop type depressions with a fault in the west and denudation in the east, but the scale of the former is much smaller.

Although the two depressions are connected and very similar to each other, there are still differences. Even the structures of the sections along the run of the Liaohe depression are different. For example, indentations in the east and in the west can be clearly divided into three sections: the northern section, the central section and the southern section. The differences between these sections and the Damintun indentation are even more pronounced. The combined length of the Liaodongwan depression and the Liaohe depression is 400 km and the variations in the alignment are very noticeable. The differences between the two depressions are as follows:

1. Among the indentations in the Liaohe depression, the indentation in west of Liaohe has the largest area and has the thickest Tertiary sedimentation rock. The average width is 20 km, the width opens up near the sea and the thickness is greatest. Once the indentation enters the Liaodongwan, the width suddenly decreases and the thickness of the Tertiary system also decreases. The maximum thickness is still 6400 m, including 1600 m of Dongying formation and 3000 m of Shahejie formation.

2. The Liaohe central boss slopes from north to south, the northern part has Tertiary overlay, the Dongying formation begins to appear in the south and Shahejie formations are found in localized regions. The thickness of the overlay increases considerably in the Liaoxi boss, the northern section has extensive overlay of Dongying formation and some Shahejie formation, and the maximum bedrock depth reaches 3000 m. As the Shahejie formation sedimented, the Liaoxi boss caused the Liaoxi indentation and Liaohe indentation to merge. The bedrock of the central boss of the Liaohe depression is Archaean group granite gneiss, but the bedrock of the Liaoxi boss is more complex, in addition to Archaean metamorphic rocks, there may also be upper Proterozoic erathem and Prolezoic erathem sedimentation rocks. Cut by the north by northeast running fault, they form a secondary tilted block fault covered by sedimentation overlay.

3. The scale of the east indentation of the Liaohe depression and the thickness of the Tertiary system are smaller than that of the west indentation, but the Liaozhong indentation is the largest and has the thickest Tertiary system in Liaodongwan depression. The maximum thickness of the Dongying formation is 2500 m and the maximum thickness of the Shahejie formation is greater than 4000 m. The sedimentation overlay is thick and well developed, including contemporaneous fault counter dragging structure and opposite contemporaneous fault compression anticline. The western side strata have obvious overlap and the northern section of the eastern side has the unique geological feature of punctured volcanic cone perimeter stratum trap.

4. The scale of the Sanjiepao sunken mountain zone in the Liaohe depression is relatively small, pinch-out occurs toward the north and south tips, and there exists lower Tertiary overlay. It is therefore not listed as secondary structural units. The Liaodong boss in the Liaodongwan depression, on the other hand, is quite large and most of the bulges do not have Tertiary overlay. The southern section has wide horst boss and the northern section has pearl bead shaped volcanic puncture of the early Tertiary period. The indentation, perhaps originally unified, is cut into two indentations and the strata on each side are strongly modified.

5. The indentation east of the Sanjiepao in the Liaohe depression is small and has a thin Tertiary system. It is the sedimentation of the coarse rock debris in the foothills. The eastern indentation in the Liaodongwan depression, on the other hand, is relatively large. The northern section was originally part of the Liaozhong indentation cut by the volcanic cone and the southern section is a scooped depression. The maximum thickness of the Shahejie formation is 2000 m.

II. Petroleum Geological Features of the Liaohe Depression

Since the Liaodongwan depression and the Liaohe depression have many geological structural features in common, they must also share many petroleum geological features. We therefore analyze the petrogeolgoical characteristics of the Liaohe depression so that they may help us in understanding the petrogeological features of the Liaodongwan depression.

1. Liaohe depression is a scoop-shaped continental syngenetic deposit primarily of the oligocene system. The deposit is asymmetric and one side of the fault is the center of the settling and the deposit. The Eocene epoch had basically no deposit, but had substantial overflow of basic lava. Beginning with the upper part of the fourth section of the Shahejie formation, it is a large area limnetic facies deposit with three major deposit cycles: from the upper Shahejie fourth section to the top of the Shahejie third section, from the Shahejie second section to the Shahejie first section, and the Dongying formation. From the bottom to the top, the magnitude of each cycle gradually decreases. The Shahejie third section is a deep limnetic deposit with the richest aquatic life and organic matters. The Shahejie first section is a shallow limnetic deposit with abundant aquatic life and organic matters. The Dongying formation second section is mostly lake facies deposit and epicontinental organic matter. Because of the deep burial, the third Shahejie section has large areas of thick mature oil-bearing strata, the conversion is advanced and is the most important oil bearing stratum, followed by the first Shahejie section. The second Dongying section is immature in most places but the oil-bearing starta may have matured at the center of the east and west indentation near the coast. The oil bearing strata and the oil centers have a prominent control effect on the formation of oil gas. Most of the oil gas reserves are located vertically in and near the oil strata and laterally in or near the oil centers.

2. A number of short rivers bring in a large amount of debris to the two sides of the depression and form various types of sand members into the lake

basin. Above and below each deposit cycle, deposit rocks are well developed, mostly in the form of delta sand members. The deltas on the steep slope are narrow, coarse, poorly sorted and small. The configuration and granularity are similar to underwater fans. The deltas developed on the gradual slopes are better sorted, larger and have finer granularity. They are still quite different from large deltas and belong to the sand delta class. Underwater fan sand members are often found in the third Shahejie deep limnetic deposits, whereas delta sand members and talus limestones are developed in the first Shahejie shallow limnetic deposits. The lower Tertiary system, especially the Shahejie formation, constitutes excellent generation and storage combinations which make the Shahejie formation the most important oil bearing stratum.

3. In the Bohaiwan basin, the lower Liaohe depression has the largest excursion resulted from the Indo-china movement and suffered the most severe denudation and weathering. Large areas of Archaean group granite gneiss are found exposed with well developed structural fissures and weathering cracks. They may become food reserve strata. The residual middle and upper Proterozoic erathem and Prolezoic erathem deposits are also good reservoirs. The entire region has basically no Kongdian formation red deposit and the dark argillaceous rocks in the upper part of the fourth Shahejie formation to the third Shahejie section are laying directly over the bedrock. The block fault tilting activities in the early Tertiary epoch help the development of the block fault in the bedrock and the oil forming strata.

4. There is a large variety of structural traps, including the counterdrag anticline trap, overlay anticline trap, and the syngenetic fault compression anticline trap. There are also a variety of Guqianshan traps, stratigraphic overlay traps, stratigraphic noncomformity traps, and lithologic traps. The extensive development of faults in different directions and in different strata often cover or divide the traps and may also form isolated fault traps. The spatial distribution of the traps provides favorable spaces for the collection of the oil gas. The size of the traps is often small and the structures are complex, it is different to obtain the details in the early phase of the exploration, but they constitute oil gas accumulation zones under the influence of local geological factors. Each oil gas accumulation zone has its particular distribution regularity. The oil reserve in non-anticlines exceeds that in anticlines and the accumulation of oil gas in the slopes exceeds that in the deep depressions.

5. The indentations are the basic units of the generation, transport and accumulations of oil gas. Each indentation is bascially an independent lake basin and most of the oil gas produced accumulate in the indentation and only small amounts of oil gas may be transported to the adjacent bulges. The differences in the geological charactersitics of the three indentations in the Liaohe depression also cause obvious differences in the oil gas abundance. The western indentation has the most varied oil gas reserve and the highest abundancy in oil gas.

III. Geological Characteristics and Oil Prospects of Liaodongwan Depression

Based on the petrogeological characteristics of Liaohe depression and the available seismic and geological data of Liaodongwan depressions we make the following predictions:

1. The Shahejie formation is thick and at the appropriate depth, it may become the major oil-producing stratum.

The third section of Shahejie will be the principal oil-producing stratum, followed by the first section. The locations of oil-producing centers may be predicted from the Isopach diagram of the Shahejie formation. The Liaozhong indentation oil-producing center is larger than that of the Liaoxi indentation, and part of the Liaoxi bulge is also in the oil producing zone. The total volume of the Shahejie oil producing strata in the Liaodongwan depression is greater than that of the Liaohe depression. Due to the increase in thickness of the upper tertiary and the Quarternary systems, part of the Dongying formation may also become mature oil-producing strata. For example, the Liaoyi well at the northern section of the Liaoxi bulge has approached the oil-producing threshold depth based on the organic conversion coefficient of the 2100 m deep Dongying formation, see Fig. 5.

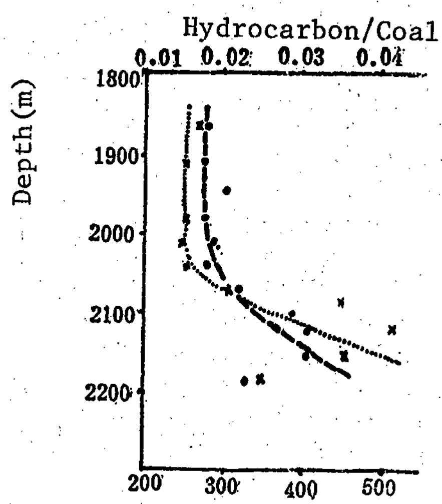

Figure 5. Organic conversion coefficient as a function of depth at Liaoyi well

2. The second section of the Shaheje formation in the Liaohe depression is the most developed stage of the delta sand member.

The strata of the Liaodongwan depression between the T_3 and T_4 seismic reflection layers correspond approximately to the first and second Shchejie formations. In such locations the fore-set [?] structures (heterotropic, tangential heterotropic, and S-type structures) are well developed and the structure is expected to be a delta sand member. They form a superior reservoir between the oil-producing Shahejie first and Shahejie third. They may be one of the most important oil-producing strata in Liaodongwan depression.

3. The pretertiary bedrock of the Liaodongwan depression has endured many structural changes and strong denudations.

The distribution range of the old metamorphic rocks with well developed structural fissures and weathering cracks may be limited, but the range of the

preserved mid and upper Proterozoic erathem and Prolezoic erathem strata in the Liaodongwan depression is greater than that in the Liaohe depression. Like the Liaohe depression, since there is no Kongian formation red deposit, the oil-producing rocks of the Shahejie formation may be in direct contact with the pretertiary bedrock reservoic, therefore, the Guqianshan oil reserve may be an important reserve in the Liaodongwan depression.

4. The basic structural configuration of Liaodongwan depression is a north by northwest rift with a drop in the western panel.

The set of rifts cut the Liaodongwan depression into strips of bedrocks with tilted block faults and scoop-shaped depressions. The overlay slides toward the direction of deep indentation. The syngenetic faults with a consistent tilting direction form a counter dragging structure and the tilted block is covered by an overlay structure. The east wing of the Liaoxi boss has a prominent overlay. The geological structure of the western slope of the Liaoxi indentation is very similar to that of the western slope of the Liaohe western indentation. The bottom of the lower Tertiary system has an overlay, the top has noticeable denudation, and there is nonconformity between the lower and the upper Tertiary systems. The eastern slope of the Liaodong depression has similar characteristics. In addition, the volcanic cone puncture at the northern section of the Liaodong boss caused stratigraphic interruption and change of shape. The Liaodongwan depression evidently has a variety of traps and the stratigraphic traps play a certain role. Extensive lithologic traps have been confirmed and they are mainly located in the third Shahejie section.

5. Most of the faults in Liaodongwan depression extend to the upper Tertiary system and provide a passage for the movement of oil gas from the lower Tertiary system to the upper Tertiary system.

The covering condition of the upper Tertiary system may also improve from north to south. Up to now no significant oil gas reserve has been found in the upper Tertiary system in Liaohe depression, but the possibility of discovery exists in Liaodongwan depression.

The geological and petrogeological conditions of Liaodongwan depression change along the alignment.

The similarity with the Bozhong depression increases to the south. To the north, the similarity with Liaohe depression increases. Therefore, the beach and shallow sea regions directly connected to the Liaohe depression are most similar to the southern part of the Liaohe depression in petrogeological properties and are the most promising regions in the Liaodongwan depression.

In summary, the Liaodongwan depression has good petrogeological conditions and its oil-gas reserve should be comparable to that of Liaohe depression. The conditions of the Liaoxi boss and the Liaozhong indentation in the Liaodongwan depression are superior to those of the central boss and the eastern indentation in the Liaohe depression. The Liaodong indentation in the Liaodongwan depession is also promising and more so toward the south. The conditions of the Liaoxi indentation in the Liaodongwan depression are not as favorable as that of the western indentation in the Liaohe depression.

The distribution of the gas and oil reserves in the Liaodongwan depression may be modeled after the Liaohe depression based on the geological structure and the corresponding oil-gas reserve distribution characteristics. Naturally, the validity is better for the northern section and not so good for the southern section, as shown in Fig. 6.

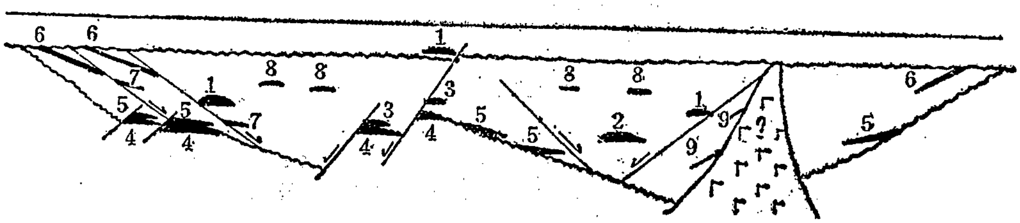

Figure 6. Model prediction of the Liaodongwan oil-gas reserve--a northwest to southeast cross-section

1. Counter-drag anticline oil reserve
2. Compression anticline oil reserve
3. Pifu [2126 6010] anticline oil reserve
4. Guqianshan oil reserve
5. Stratigraphic overlay oil reserve
6. Nonconformity oil reserve
7. Fault-lithologic oil reserve or sandstone uptilt pinch-out oil reserve
8. Sandstone lens oil reserve
9. Volcanic cone puncture oil reserve

IV. Prospecting Approach for Liaodongwan Depression

Based on the discussion above, it is quite natural to place the priority of prospecting on the northern section. Not only the general geological conditions of the northern section are similar to that of the southern part of the Liaohe depression, many oil gas accumulation zones in the latter directly extend toward the sea and make the prospecting most practical at Yuanyanggou, Shuangtaizi, Haiwaihe and Rongxingtun. The efficiency will be higher since the oil gas distribution of the Liaohe depression and the previous prospecting experience and methods may be used as a guide. At the present time the priority should be placed on the seismic prospecting of the shallow beach and the shallow sea at the northern part of Liaodongwan. This region makes up about 1/4 to 1/3 of the area of Liaodongwan and has never been explored seismically. Seismic measurements should also be conducted to construct an oceanic and continental diagram. Systematic seismic and stratigraphic studies should be made to assess the distribution of the sand members and the location, shape, and type of the traps. A small number of wells may be drilled as parameter wells and pre-exploration wells. The locations should be in northern part of the Liaodongwan depression to cover the local structures in Liaoxi indentation, Liaoxi boss, and Liaozhong indentation. The first well may be drilled at Ertaijie between Liaoxi boss and Liaoxi indentation. The petrogeological conditions of this location are very similar to those of the Xinglongtai oil field in the Liaohe depression. In terms of the Guqianshan oil reserve, it may be even better and may serve as the starter well.

V. Conclusion

The petrogeological conditions of Liaodongwan are simliar to that of the Liaohe depression. It is the most promising and the largest area in Bohaiwan basin that has not been explored for oil and gas. It should be listed as today's priority area for prospecting.

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OIL AND GAS

NAPPE-SCREENED OIL POOLS AND PROSPECTS FOR THE KARAMAY OIL FIELDS

Jiangling SHIYOU YU TIANRANQI DIZHI [OIL AND GAS GEOLOGY] in Chinese Vol 5, No 1, Mar 84 pp 1-10

[Article by Lin Longdong [2651 7127 2767] of the Xinjiang Oil Administration Bureau: "Discovery of Nappe-Screened Oil Pools and the Prospects for the Karamay Oil Fields"]

[Text] Surface prospecting began in the Karamay oil fields, located on the Kexia fault terrace zone of the northwest margin of the Junggar Basin in 1951, oil was produced in October 1955. By the early 1960's the Triassic oil pools of the headwall and footwall of the principal fault had been discovered, and in the mid-60's the Permian oil pools of zones 8 and 5 had been discovered. With this its features began to emerge.

The Karamay-Wuerhe fault (abbreviated Ke-Wu fault) that thrusts through the oil fields was more or less located by seismic and drilling data as early as the 1950's, but as study began on the relationship between this fault and the high production, several viewpoints emerged. From 1965 to 1978 there were no great advances, but since 1979, with each new breakthrough in the understanding of faulting, with every advance in seismic prospecting equipment and techniques, there has finally been new developments in finding oil along this fault, based on a variety of geological information on the deep parts of this fault.

I. The traditional understanding of the Ke-Wu fault.

The Karamay oil field is an oil field in a regional monocline cut off by faults and surrounded by trapping faults. The Ke-Wu fault is a large hidden fault zone made up of such faults as the Karamay, the Baijiantan, Baikouquan and the Baiwu (Figure 1). In the 24 years from the discovery of the oil field until 1979, it was universally held that the fault was a high-angled reverse fault, with the fault plane dipping to the northwest with a dip angle of 60 to 80 degrees, and that the dip and angle continued downward, dividing the Karamay oil field into several independent fault blocks. Because high producing areas were regularly found in the oil bearing territory of the footwall, and because wells with more primitive oil and gas and core samples showing more fissuring were most abundant near the fault, and the Kexia formation (T1/2) oil reservoir strata is distributed widely on the headwall

and footwall, while the Keshang formation (T2/2) is mainly distributed to the north of the fault, with scattered data showing it to the south, it was deemed that the high production zones came from the footwall, with a strong relationship to the trapping qualities of the fault and the high permeability zones existing nearby. It was imagined that during its active periods the fault had created excellent migration routes for oil and gas, causing many strata in the fault zone to contain oil; structural trapping occurred during the quiet periods of the fault zone, causing oil and gas to accumulate and be preserved in the footwall. This was the concept of the Ke-Wu fault that held over the years.

II. Discovery of the nappe-screened oil pool.

In the latter half of 1979 a fault was found in the western part of the area of well Bai 21 (i.e. the Baikouquan fault) when exploitation of the Baikouquan oil field began, and it was not the sort of high angled reverse fault that had been supposed; but it was a reverse fault with a low dip angle of 20 to 40 degrees, plowshare shaped in cross section, the top steep and the bottom gentle, with the concave side face up. This not only swept aside twenty years' worth of our understanding of the characteristics of the Ke-Wu fault, but, because here in this overthrust zone (nicknamed the "Fault Hat Brim"), most of the wells drilled into the pay zone of the Baikouquan formation (T_1) were big producers, this new beakthrough in understanding had real economic value (Figure 2).

It has now been determined that in the fault overthrust area not only does the Baikouquan formation hold oil, but the Kexia formation (T1/2) and the Keshang formation (T2/2) do also, and the oil bearing area increases from top to bottom; this is a rich multi-strata oil and gas zone.

Very good economic benefits resulted from the discovery of the gently sloped part of the Baikouquan fault in 1979. But was this gentle fault plane a local phenomenon or a regional characteristic? What practical meaning did this have for regional prospecting? Questions like this called for quick answers. So in the latter half of 1979 we sank 377 wells into the Karamay fault, and made 262 cross-section profiles to effect serious analysis, and with the new data, several important phenomena were found:

(1) In the absolute majority of wells drilled into the steep zone on the top of the fault logging data and core sample data proved that in that part of the fault the dip angle would approach 60 to 80 degrees.

(2) Two or more wells drilled into the fault were enough to determine that the fault plane alone had nine profiles, and the apparent dip graphed out to 10 to 60 degrees. After careful analysis of the nine profiles it was found that there was a relationship between the dip angle and the stratigraphic position of the point of the fault. If two points are fairly high up on the fault (newer) then the angle will be steeper; conversely, if two points are lower on the fault (older) the angle will be more gentle. This manifests the characteristics of the plowshare shaped fault.

(3) Two places have been found where the fault face slopes gently beneath a limesone series headwall. One is on the boundary of zones seven, eight and nine on the profile line between well Jian 73 and well 5104; all were drilled through the limestone headwall and into the Jurassic and Triassic of the footwall before drilling was completed. The apparent dip angle there is 17 degrees (Figure 3). The second place is on the boundary between zone six and the middle western part of zone seven, on the profile line between well 7255 Shang and well 2 - 1. The fault plane dips at 35 degrees (Figure 4). Although wells like this, drilled through limestone and into the Jurassic and Triassic are not numerous, they clearly show that when the lower section of the fault occurs beneath a limestone headwall, the dip angle is quite gentle.

This signified that the Ke-Wu fault may not be a high angled reverse fault; it possessed certain characteristics of low angled reverse faults as well. In order to ascertain the structure of the fault zone, 30 new seismic lines were made and a number of test wells and exploration wells were drilled along the entire 55 kilometers from Baijiantan to Baikouquan in an attempt to unravel the riddle of the Ke-Wu fault. This knowledge has been gained through recent years' exploration:

First, the Ke-Wu fault is by its nature a reverse fault, it is a complex fault zone. Its reverse fault nature is not limited to some few locations, it is of a general nature. Generally it is steeper up high and gentler down below, with a convex face up. The fault has been found to be as steep as 60 to 80 degrees in many places on its leading edge, often in the vicinity of Jurassic and Triassic series in the vicinity of the fault. But the recently revealed lower half of the fault is really quite gentle, with a dip of 15 to 40 degrees, occurring beneath the limestone of the headwall. The limestone of the headwall has been reverse faulted over the Jurassic and Triassic series of the footwall. The dip angle is not quite the same from place to place, it is fairly gentle, 20 - 30 degrees in the middle section of Baijiantan fault zone seven, and in the area of well Bai 21 on the Baikouquan fault. On the South Baijiantan fault it is 30 - 40 degrees, but can be as little as 15 degrees on the Karamay fault (Figure 5). It is not a unitary fault, but a complex fault zone composed of several faults (Figure 6). The Karamay is the principal fault, secondary faults have developed along its flanks, some parallel, some intersecting, creating a fault block whose leading edge varies in size.

Second, because of changes in the fault's elements of attitude, nappe screened oil pools occur, what are commonly called the "fault hat brim" oil pools, and this is an area for exploitation that was left out in the past. As for certain oil accumulating strata, the width of the hat brim (nappe zone) is determined by the dip angle of the fault plane and the size of the vertical fault separation.

The times and strength of faulting action in the various faults of the Ke-Wu fault zone were not the same, as is shown by the fact that their stratigraphic position and vertical separation are not the same. Table 1 shows the narrowness of hat brims in Triassic oil accumulating strata. The faults are all

arc-shaped in figure, with the greatest separation at the apex and the least in the two legs. Of those we have discovered, the hat brims in zone five are the narrowest, and those in well Bai 21's area are the widest.[1]

After the first discovery of the "fault hat brims" in the western part of well zone Bai 21, on the Baikouquan fault, the oil bearing hat brim area increased with middle zone 7, zone 8 and zone 5. Fifteen oil bearing strata blocks were found in and around fault hat brims over four years' time. Considerable geological reserves were proven, a real contribution to unbroken increases in production in the Karamay oil fields in recent years.

Third, some preliminary indications of reverse fault seismic time sections have been found. In the past, we relied on seismic reflected wave time sections made by spot and analog magnetic tape seismographs as a basis for determining that the particulars of the Ke-Wu fault were: a. shallow Jurassic reflection boundaries produced inflexion point positions of refraction curves; b. the footwall reflected back the strong waves' mid break point position from the reflection boundary; and c. the boundaries of the distribution of reflected waves off the northwest dipping headwall limestone series.[2] But between the strong wave mid break point on the footwall and the reflected waves from the northwest dipping headwall, there was a fairly wide triangular blank zone. Several years work with digital and source seismographs, coordinated with test well data has shown the blank triangles to be fault hat brims, with stratagraphic position beneath the northwest dipping reflecting wave limestone formations of the headwall (Figure 7). Because there was usually a strong group of reflected waves (Ct_3) with a three second lag coming from the footwall on most time sections, and this wave group was found along a line from Chaozhayier Shan to Halaalate Shan, their ending point was not found on the vast majority of sections, and now we can use the narrow "conduit" between these waves and the reflected waves off the northwest dipping limestone headwall to extend our reach to lower positions on the fault face; that is to say, the fault face is known not to penetrate through this strong wave group. Thus, using seismic exploration we are able to fix the position of the fault fairly precisely, and understand the circumstances under which the fault plane extends, entailing profound changes in our understanding of the features of the fault structure.

III. The future for prospecting.

Discovering the model of the Ke-Wu fault structure not only led to prospecting for nappe screen oil pools, it also ushered in a high tide of exploration of high fault blocks along the principal faults in the headwall, turning up several "small but rich" oil bearing fault blocks, and giving us a new understanding of the characteristics of the Kexia fault border zone on the northwest margin, as well as a theoretical understanding of oil production and oil and gas distribution.

A. The Kexia, reverse fault zone or reverse nappe screened zone?

Beyond the wells sunk from Baikouquan to Baijiantan, the Ke-Wu fault runs about 250 km, from Hongqi dike in the northeast to Qianshanlao dike in the southwest. Complete cross sections using detailed seismic studies and test well data have begun to show that this fault not only manifests the characteristics of a reverse fault, but it is also a large reverse nappe zone (Figure 8), and the structure is made of three components, from bottom to top: 1. Footwall nappe screened zone and its leading edge; 2. Headwall nappe body; 3. Mesozoic overlapping pinched out zones. The nappe structure began to be formed during the mid to late Variscan orogeny, took its shape during the Indosinian movement, and activity ceased during the Yanshanian period; upper Jurassic (J_3) and Crètaceous (K) sediments were then deposited on the fault zone, making it into a large scale hidden fault zone. It was formed early, the activity went on for a long time, and it manifests the rare characteristics of the reverse nappe paragenetic fault.

Nappe screened zone: This indicates the part covered by Carboniferous below the face of the main fault, chiefly Permian and Carboniferous; the dimensions of the nappe screened area reach 11 by 30 km; there are also Jurassic and Triassic series on the leading edge of the fault, the nappe screened area is 1,000 by 300 meters. If the nappe screened zone contains oil, then it is a "hat brim oil pool." The front edge of the nappe screen is the Permian-Carboniferous interface. The structural morphology of that area, according to data we have, is this: it forms a monocline plunging southeastward to the west of Baikouquan; east of Baikouquan it develops into a three row synclinal structure, from north to south in echelon the Hashan syncline, the Fengchengcheng syncline and the Xiazijie syncline (Figure 1).

Nappe body: This refers to a geological body from three to five kilometers away which sometime during geological time was bent back in a plowshare shape. On top are Jurassic and Cretaceous series overlapping unconformities, and the bottom boundary is the nappe fault face. It begins on the south at the main fault and on the north it may run as far as the vast area of the Daerbute fault. It is formed principally of limestone series. Drilling and seismic data shows many well developed small faults in the nappe body; in the deeper parts all faults have the appearance of merging and convergence.

Overlapping pinched out zone: This refers to a pinched out geological body of sediment overlapping the nappe body. The strata that comprise this zone include Triassic, Jurassic and Cretaceous series, some of these have been influenced by the faults in the nappe body, some have not been influenced, so the surface appearance varies from place to place. The Karamay and Baijiantan areas are faulted through all the way to the Middle Jurassic, the other areas are faulted through to the Jurassic, with the faulted strata closest to the edge of the old mountains being the newest. See Table 2.

It can be seen from this that hidden beneath the nappe body is a vast new territory for prospecting, the nappe screened body. This is the place endowed with fault nappe-screen oil reservoirs that has attracted everyones' attention!

B. The oil bearing rock of the northwest margin of the Junggar basin is possibly marine facies limestone.

Prior to 1979 the expert opinion on the genesis of the crude oil in the Karamay oil field was that it had come from the Permian series oil generating depression east of Maersi Hu. That depression was shown by seismic surveying to have 14,000 square kilometers of sedimentation, with the Permian alone being 4,000 to 4,500 meters thick. Because the depression is very deep, no well has penetrated through it. That series forms diluvial and alluvial rough fractured slack sedimentation; the distant Wulumuqi Permian series is oil shale; it was theorized that these strata in the center of the depression east of Manasi Hu were fine deep lake bottom facies sediments, good oil producers. Deeper down in the depression as more and more strata were piled above and the static pressure increased constantly then the oil would migrate to the strata on the edges; then it would migrate up to the Triassic series headwall. This was the famous theory of lateral migration along Triassic and Permian unconformities. In 1979 as the drilling was revealing the gentle fault face of the Ke-Wu fault, an important discovery was also made through seismic prospecting, and that was that the cross section of the Carboniferous and Permian series in the northwest margin were two thick "trumpet mouths" whose thicknesses increase in complementing directions. The Permian becomes thicker and deeper from northwest to southeast, the Carboniferous is complementary and becomes thicker and deeper from northeast to southwest, being thickest in the vicinity of the Ke-Wu fault between Baijiantan and Baikouquan, with a depth of 4,200 meters (the phenomenon of faults overlapping to increase thickness has not been discovered), all the way to Chaozhayier Shan and Halaalate Shan. In the Fengchengcheng area, the Carboniferous series' principal constituents are a deep grey or grey-black colored dolomitic mudstone or dolomitic tuff; the stratification is distinct; there are fossils of aquatic plant and marine lily stems and mussel-shrimp, etc. The Boron content is greater than 1,000 ppm, the Strontium to Barium ratio is greater than 1, the sedimentation is that of a marine to continental transition facies coastal lagoon or gulf. The average organic carbon content is 1.29 percent; there are 1,400 ppm of asphalt "A"; the organics are of the decayed mud and mixed types. The vitrain reflection ratio (R_o) is 1.17 percent, a good one. It is well-matured oil generating rock. But the Permian, based on data from well Aican 1, has an organic carbon percentage of 0.67, 159 ppm of asphalt "A," and a vitrain reflection ration of 1.17-1.78 percent. It is a not-well matured oil generating rock. In a comparison of crude oil and oil generating rock, the steroid alkane, terpane parameter and massed analysis methods and other geochemical indicators were used; representative samples of oil were taken, and compared to samples of possible oil generating rock from the Jurassic through the Cretaceous, revealing fairly distinct similarities between the marine facies Carboniferous oil generating rock and Karamay crude oil. As more data becomes available, it indicates that the source of Karamay crude oil probably comes chiefly from the Carboniferous series[3], the sedimentation depression of that series lies below the Karamay oil field. This depression is "over on the inside and broken on the outside" (that is, it overlaps the center of the basin and faults are developed along the outside of the basin). The oil produced migrates vertically along faults and fissures to the Permian, Triassic,

Jurassic and headwall Carboniferous series, then begins a lateral migration away from the reservoirs there, accumulating in various traps, having undergone numerous structural changes, finally forms the present oil, gas and water distribution. This provides a theoretical basis for prospecting on the headwall nappe body and the footwall Carboniferous and Permian oil reservoirs, and bolsters our confidence in our exploration.

C. Characteristics of oil and gas distribution in the fault zone.

In the past the rules for distribution of oil and gas in the Ke-Wu oil zone were thought to be controlled principally by the factor of sedimentation, and were related to the development of the cone shaped Triassic and Permian alluvial deposits. According to this theory, the center rough fractured slack facies zone of the alluvial cones would be a good oil and gas bearing area; the lithologically fine facies zone bounded by two alluvial cones and with a low structure was thought not to be a good oil and gas bearing area. In summing up the results of studying these rules for the oil-bearing faults and the high productivity of the faults, it was also concluded that after the faults cut through the cones, many strata in the vicinity of the faults were made oil-bearing, and that the high productivity of the fault zone was the result of the faulting improving the nature of the reservoir beds. Thus, oil finding was strictly limited to the fairly good alluvial cones.

From 1978, with the prospecting of the oil pools in the Badaowan formation in areas 8-10 (J1/1), and especially after finding the nappe-screened oil pools of the Ke-Wu fault, it was becoming ever more clear that the Ke-Wu fault was an oil and gas enriched zone that was not limited to alluvial cones, and there were four good territories within this fault zone for oil prospecting[4] (Figure 8):

1. The front fault-block zone of the nappe.

This refers to several fault-trapped fault blocks in the vicinity of the principal fault; some are apparent and some are hidden (that is, the concealed shapes), some are on top and some are below, in congruent forms. In actuality they are part of the nappe body and the overlapping pinched out zone, e.g. areas 6 and 7, fault-block J188 and 246, the Xiahong north fault-block, well Xia 23 fault-block, and so on. These are mostly multi-strata oil-bearing fault-blocks to the point that wherever a fault occurs, oil will accumulate in it. Oil and gas enrichment was not only limited by the length of the period of faulting activity, but also by the size of the fault span; the concealed high producing fault-blocks frequently are found in places with fairly large fault spans. The oil pools are mainly fault block oil pool types and strata unconformity oil pool types. This accumulation zone has the most oil bearing strata formations of any of the fault zone oil prospecting territories, it has the richest unit area accumulation and the highest ratio of prospecting success. Recently in the Hongshanju, Wuerhe, Fengchengcheng, Xiazijie and other areas new oil seeps have been discovered, encircling block by block of oil bearing area, all following along this zone. Prospecting along the fault zone has already shown the oil bearing areal connections of

the different strata systems of the Karamay and Baikouquan oil fields; the target now is to show oil bearing areal connections for the Baikouquan and Wuerhe, the Xiazijie and even the Karamay and the Hongshanju and Qianshanlao dike.

2. The main part of the nappe body.

This refers to the long narrow zones between the Daerbute and Xiahong north faults, and between the borders of Zhayier Shan and the Karamay and Hongche faults. This was viewed to be nothing more than the underpinnings of the Mesozoic sediment basin, and no goal for prospecting; now, commercial oil flows have been brought in the Huwan area and area 9, and prospects are good. Dilute oil is the primary product and heavy oil the secondary product. But on the two flanks of the oil area, Fengchengcheng and Qianshanlao dike, thick oil may be the primary product, the degree of oil and gas enrichment being related to the distance to the main fault, generally the closer the better. The lithology of the oil reservoir rock is mainly basalt and andesite, next is tuffaceous clastic rock. The oil pools are of the lithologic and strata unconformity types, good territory for future prospecting.

3. The footwall of the nappe body: the nappe-screen zone and its leading edge.

This zone includes the Jurassic and Triassic strata near main fault under the bottom of the nappe body, as well as the three peripheral areas: the deeper Permian and Carboniferous strata and the leading edge of the nappe screen body.

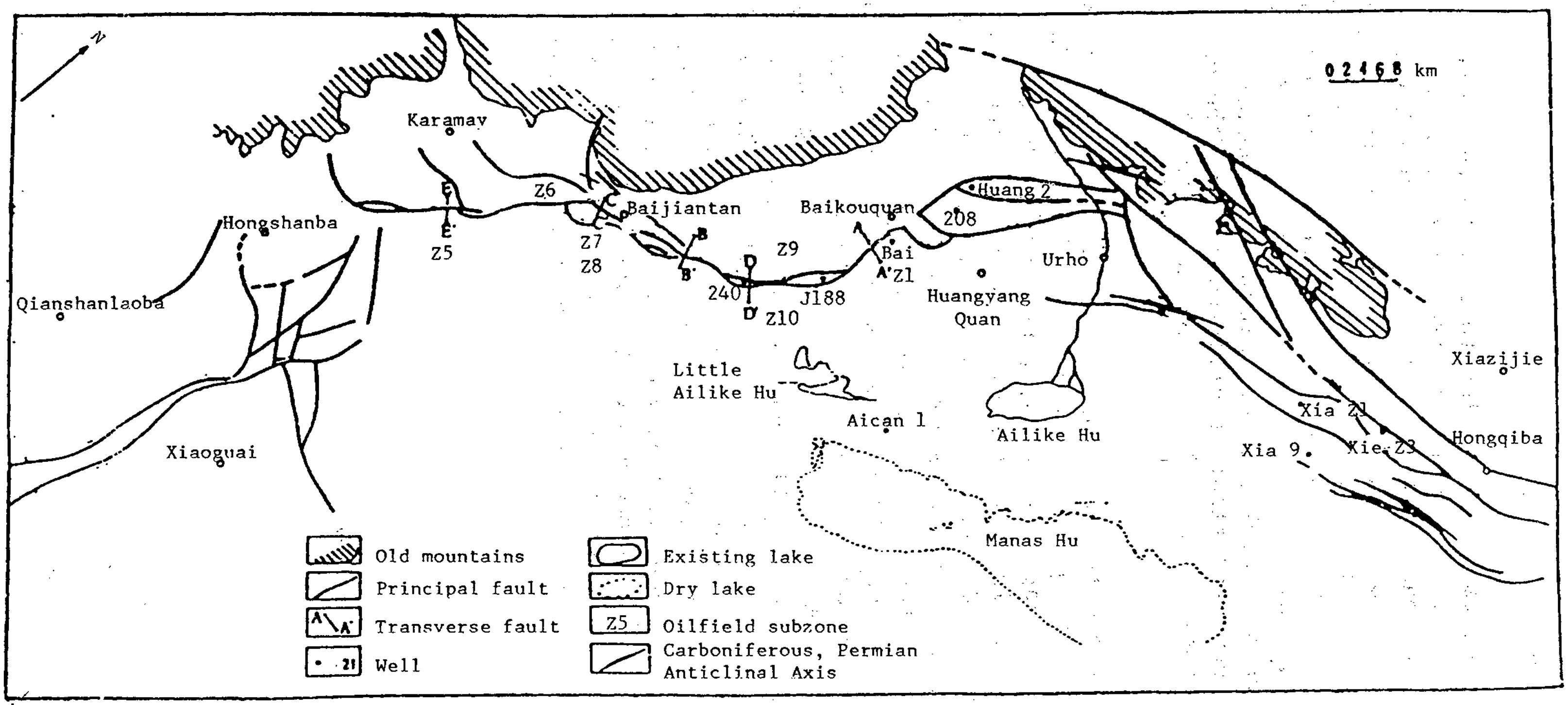
The development of nappe-screened oil pools in the Permian and Triassic faults in the middle of the fault nappe screen zone is often interdependent with the oil and gas pools in the deep parts of the footwall of the main fault; most are located in places where the structural position is high, the fault plane dip angle is small, and the fault span is large.

The deep part of the nappe screen zone and the periphery of its leading edge are now territory for proper exploration; Permian and Carboniferous oil pools have already been found in areas five and eight, and the Carboniferous series medium high producing oil flow discovered at well Feng 3 is on the periphery of the leading edge of the nappe screen zone indicates the future for prospecting on the nappe screen zone is very good, especially if attention is given to finding structural traps, fault trapped oil pools and zones with developed fissuring in the nappe screen zone. In the eastern part of this area, the Fengchengcheng, Hashan, Xiazijie anticlines and the nappe screen zone beneath the Huwan area all are hopeful territories for prospecting, they are evaluated as fairly good but the reservoir beds are not up to par; they are all of the fissure oil pool type, and exploration carries a high degree of difficulty.

4. Overlapping pinched out zone.

The common characteristics of the sedimentations in this zone are that they overlap strata by strata, they make good reservoir beds and they are not buried deep. They are renowned for large area over which exist rich resources of thick oil. Some thin oil exists on the bottom of the Triassic series and in individual locations. The thick oil is more to the north and to the top; the thin oil is more to the south and to the bottom. The distribution of oil and gas is frequently dependent on the presence of Paleozoic unconformities, i.e. oil bearing strata generally touch Paleozoic unconformities. As the sediments were laid down and strata overlapped strata, the oil bearing positions become increasingly newer. The oil pools are mainly of the asphalt trap type.

We can see from the above that our opinion of the Ke-Wu fault has developed from high angled reverse fault to gentle fault plane reverse nappe fault, and now to a great reverse nappe screen zone, reflecting three stages in understanding of the faults. The target strata for prospecting have changed from the Triassic, Jurassic and Permian systems to the Carboniferous and Cretaceous. The whole fault zone comprises four territories, all good places for prospecting, and of these four territories only the overlapping pinched out zone and the leading edge fault block were prospected in the past. The nappe zone and the nappe screen zone beneath it are new territories just opened up for prospecting. In the past most prospecting was concentrated on the middle of the fault zone. Work has now just begun on the northeast and southwest portions. It is clear that there is great potential for finding oil on the large Kexia reverse nappe screen fault zone, although the risks and difficulties are greater than those in the past. Still, the outlook is favorable. There is no doubt that lessons can be drawn from the experience of discovery of the rules of oil and gas distribution, the structural characteristics and the fault models for the northwest margin of the Junggar basin, and these can be applied to prospecting in the north, east and south parts of the basin.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Xie Z3
Xiazijie
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Principal fault
Transverse fault
Well
Existing lake
Dry lake
Oilfield subzone
Carboniferous, Permian
Anticlinal Axis

Figure 1

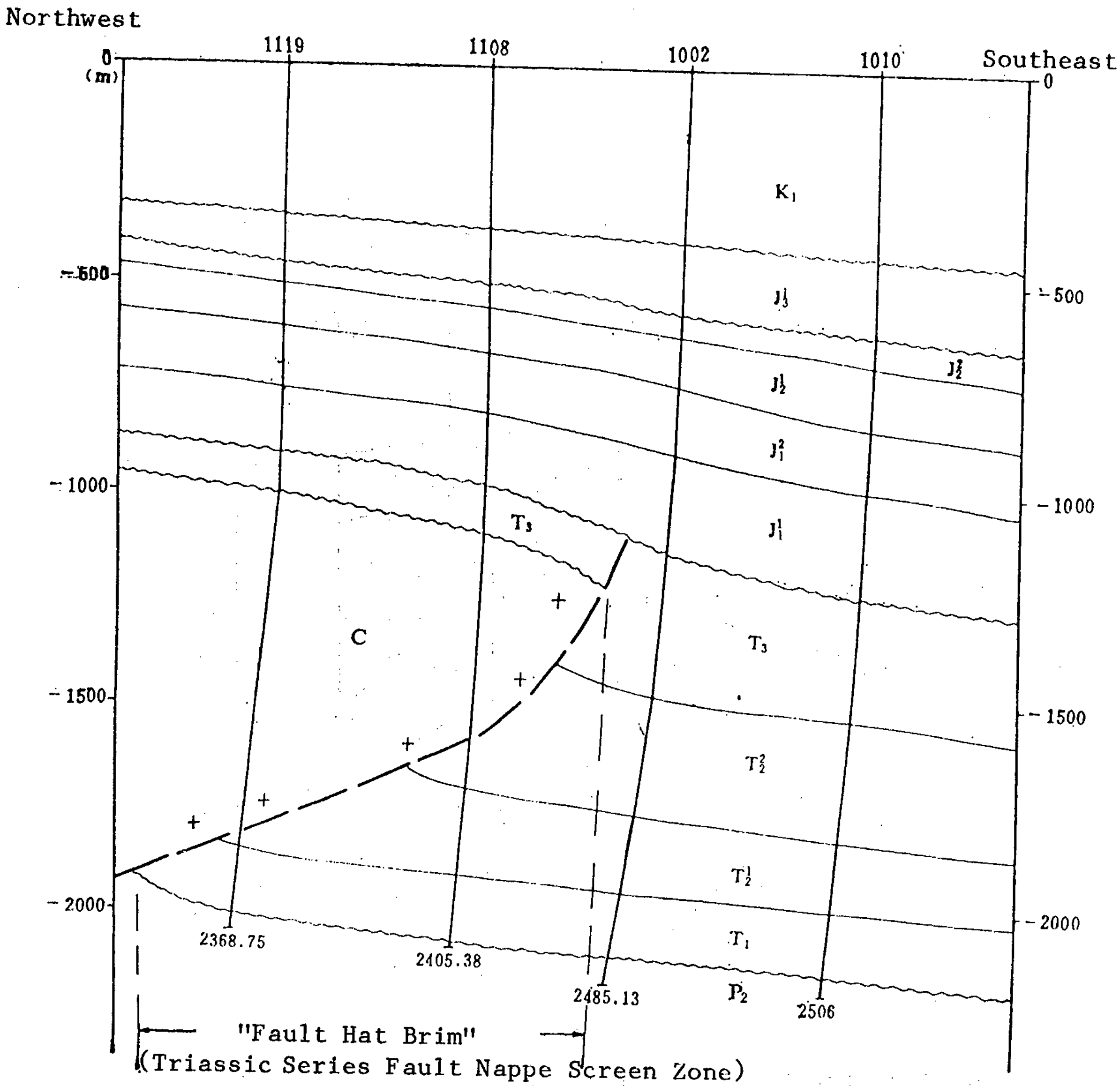

Figure 2. Cross section of the fault in well Zone Bai 21 of the Baikouquan oil field (A-A').

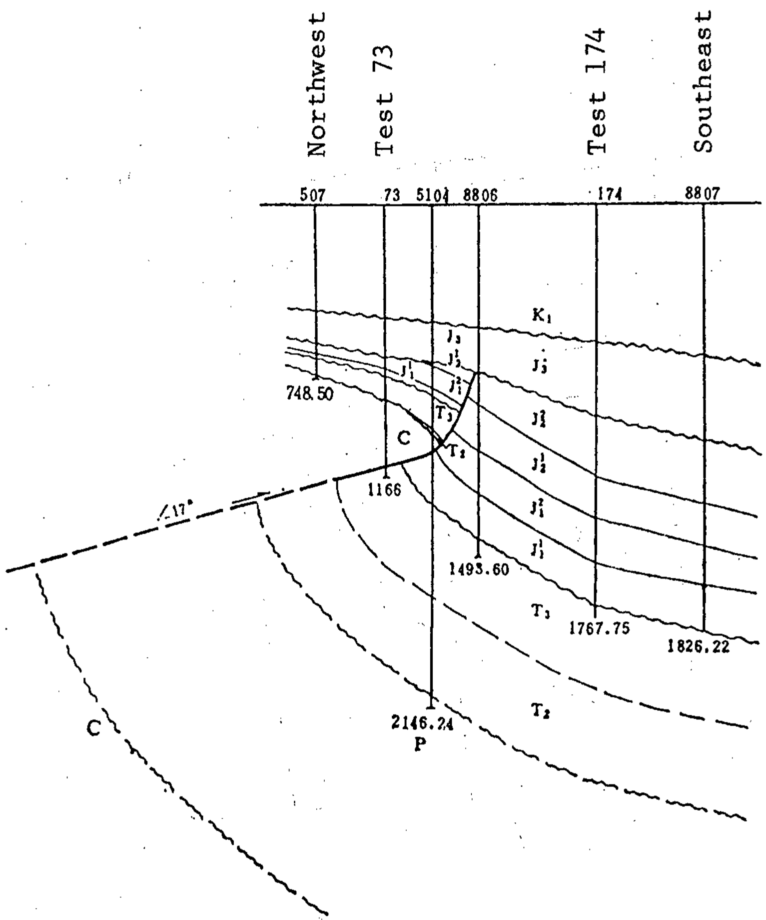

Figure 3. Structural cross section at well Zone 530 (B-B').

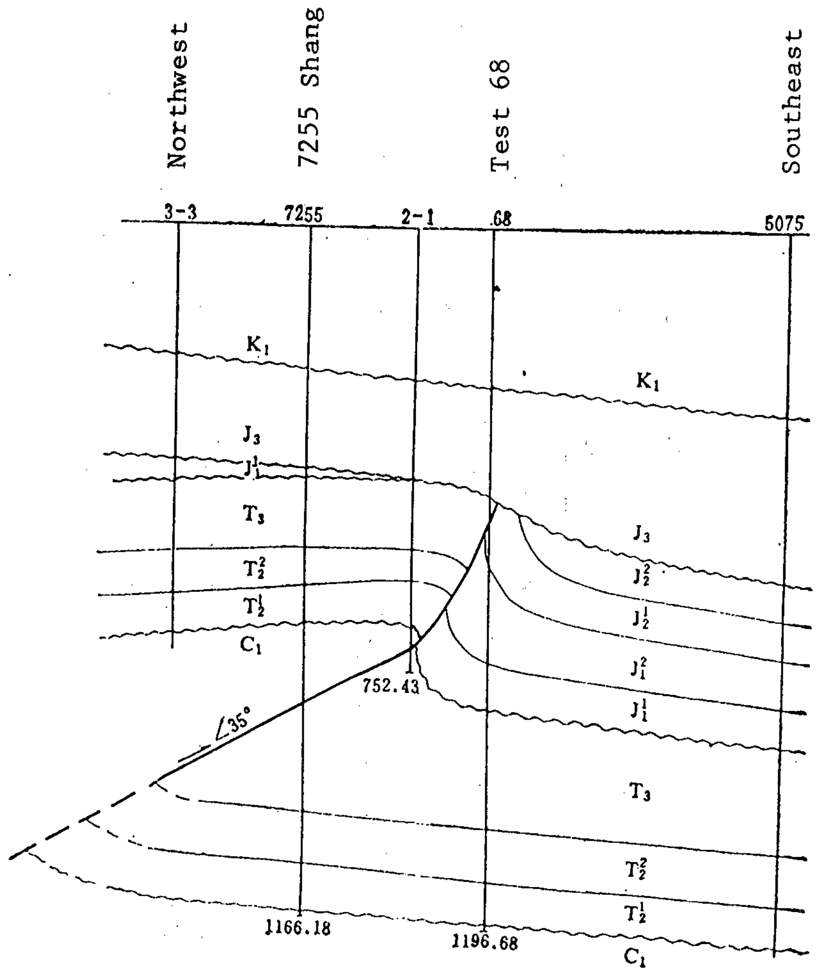

Figure 4. Cross section of Zone 7, wells Shang 7255 -- 2-1 (C-C').

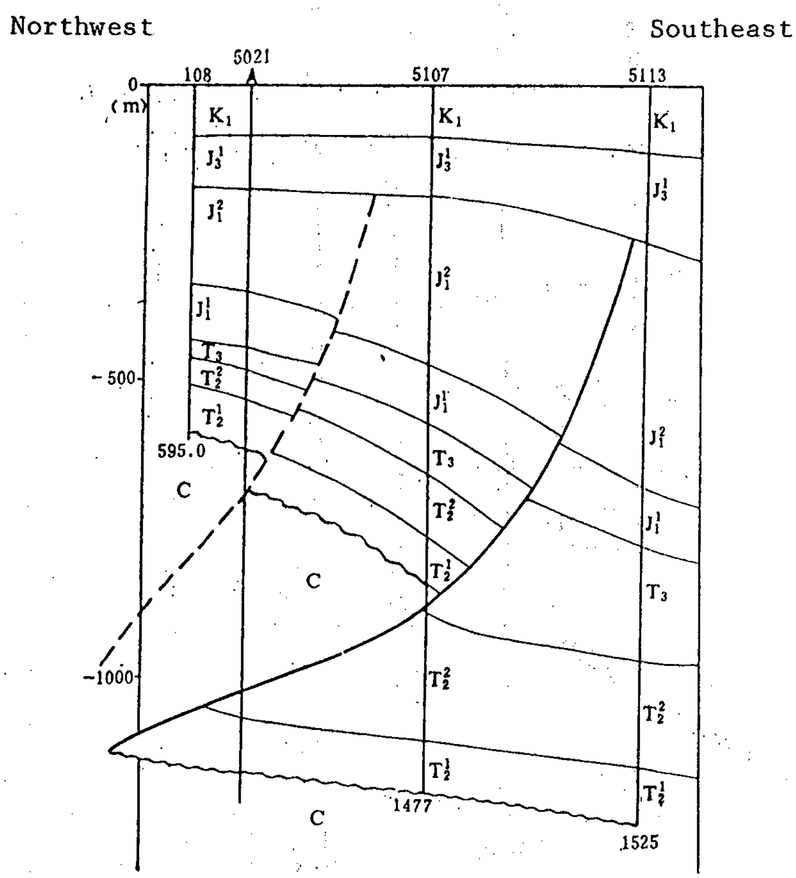

Figure 5. Cross section of the Karamay fault (E-E').

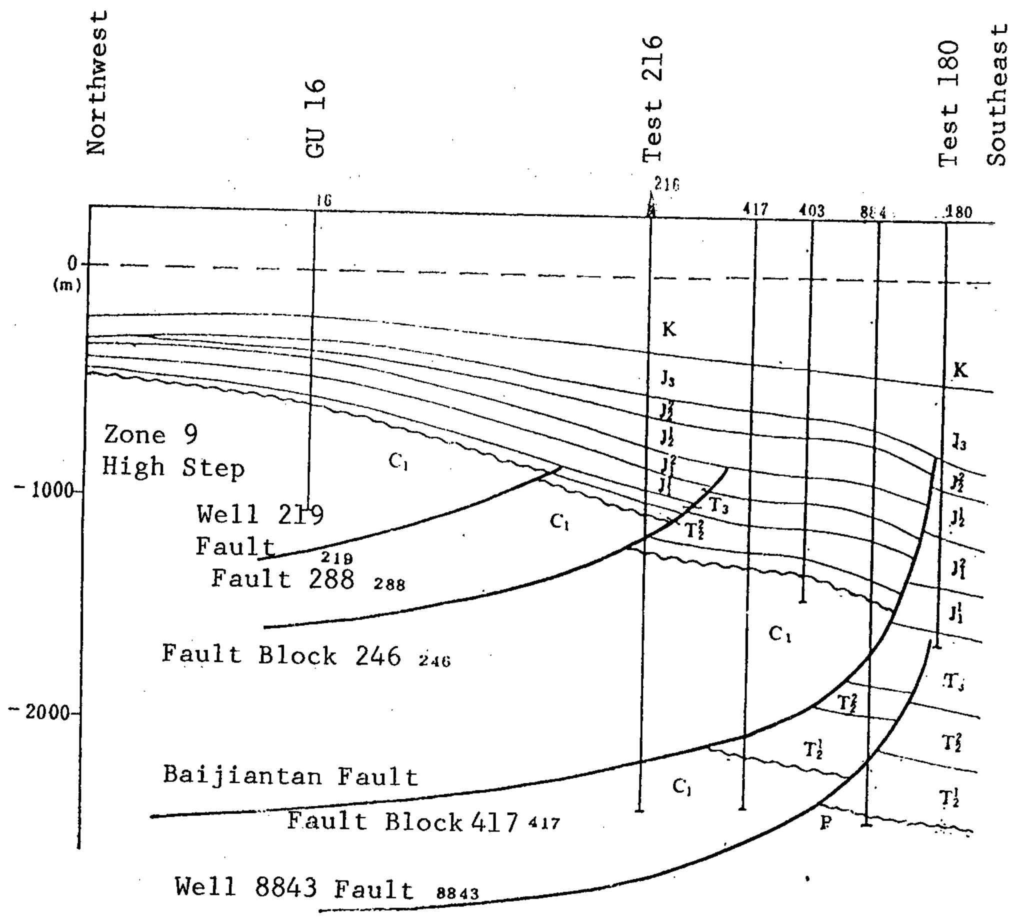

Figure 6. Structural cross section from well GU 16 to Test 180 on well Zone 246 (D-D').

Table 1.

Fault / Characteristics	Karamay Fault	Baijiantan Fault	South Baijiantan Fault	Baikouquan Fault	Baiwu Fault
Faulted Position	J2	J2	J2	T	T
Vertical Fault Span at Bottom of Triassic	200-400M	400-1000M	250-800M	200-800M	300-600M
Width of "Hat Brim" at Bottom of Triassic Series	400-500M	600-800M	800-1000M	1000M	200-600M

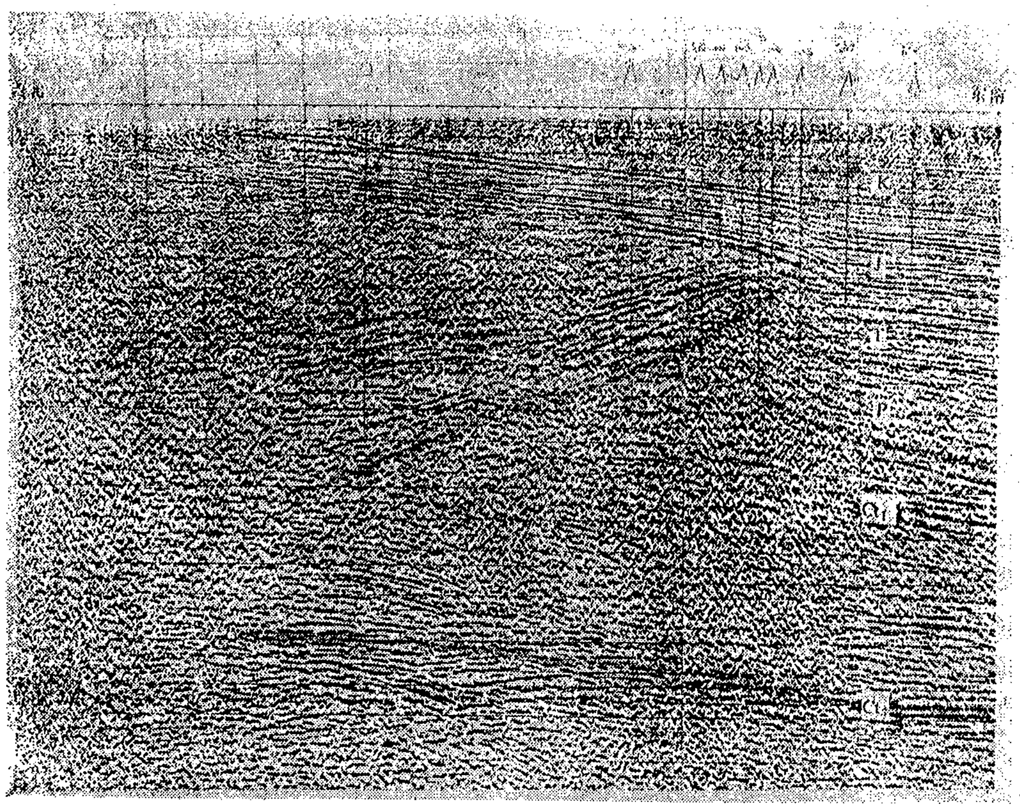

Figure 7. Cross-section of average stacking time on line Bai 8010.

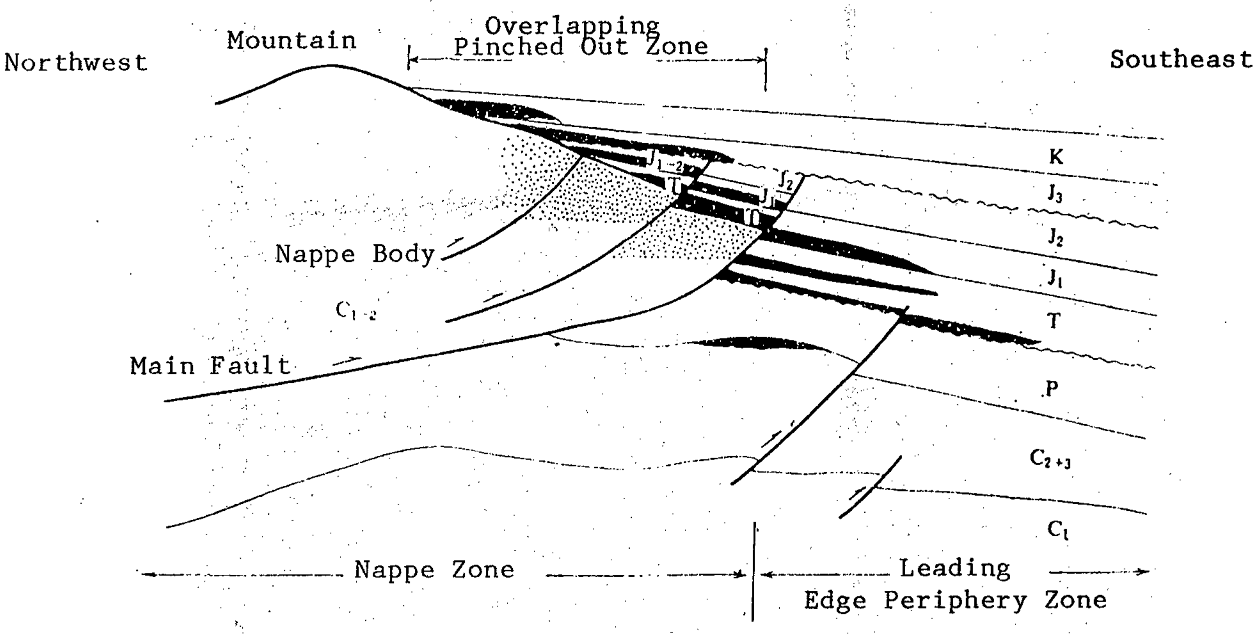

Figure 8. Structural model of the Great Kexia reverse nappe screen zone (with added indicators of oil pools).

Table 2. Characteristics of the Reverse, Nappe and Nappe Screen Zones

Basic Characteristics	Strata			Characteristics: Reservoir Quality			Structural Characteristics	
Geological Structure	Position	Facies	Reservoir Lithology	Effective Porosity (%)	Permeability Ratio (Millidarcies)	Pore Type	Width of Nappe Screen (Km)	Faulting and Structures
Overlapping Pinched Out Zone	K	Littoral Lake	Fine Sandstone	35	1704-3085	Intergranular Pore		Basically Unfaulted
	J3	Littoral Lake	Medium Sandstone	34	2310-6783			
	J1-2	Riverbed	Breccia, Medium Sandstone	20	112	Intergranular Space		Faulting Common
	T	Diluvial	Breccia, Medium Sandstone	13-22	109-150	Pores within Granules		
Nappe Body	C1+2	Seabed Eruption	Basalt, Andesite	8.8-10.4	0.37	Solution Hole & Fissuring		Small, Well Developed Faults, Some Forming the Leading Edge Fault Block

[Table 2 continued on following page.]

[Table 2. Continued]

Basic Characteristics	Strata			Reservoir Characteristics		Quality	Structural Characteristics	
Geological Structure	Position	Facies	Reservoir Lithology	Effective Porosity (%)	Permeability Ratio (Millidarcies)	Pore Type	Width of Nappe Screen (Km)	Faulting and Structures
Nappe-Screen Body & Its Leading Edge	J1	Riverbed	Breccia, Medium Sandstone	17-18	45-70	Intergranular Pore	0.15-0.3	Fault-fold East of Baikouquan
	T	Diluvial	Breccia, Medium Sandstone	13-39	144-323	Intergranular Pore & Intragranular Solution Hole	0.4-1.0	
	P	Diluvial	Breccia	9	0.88	Microscopic Fissures	8-11	Monocline West of Baikouquan
	C2+3	Gulf or Lagoon	Dolomitic Mudstone, Dolomitic Tuff, Andesite & Volcanic Breccia	6	0.2	Microscopic Fissures & Eroded Holes	18-30	

FOOTNOTES

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12663
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OIL AND GAS

UNTAPPED GAS RESOURCES COULD SOLVE NATION'S ENERGY PROBLEMS

Chengdu TIANRANQI GONGYE [NATURAL GAS INDUSTRY] in Chinese Vol 4, No 1, 28 Mar 84 pp 30-32, 26

[Article by Fang Sheng [2455 3932], Planning Bureau, Ministry of Chemical Industry]

[Text] China is richly endowed with natural gas resources [and] the prospects [for development] are very bright. Particularly optimistic is the potential for coal-formed gas. Thus, it has been proposed that, in the energy field, the nation take on the important mission of prospecting for and developing natural gas, and strive for major breakthroughs within the next 5 to 10 years.

I. Natural gas accounts for one-fifth of the world's energy resource production.

Worldwide, natural gas has become an important element as a raw material for energy and for chemical industries. According to the statistics for 1981, natural gas accounted for 19 percent of energy production, and 22 percent of consumption, whereas in China it only amounted to 2.6 percent. According to studies, one important reason for the low production of natural gas is that for a long time it was not given much importance; general reconnaissance and prospecting were neglected, and particularly, not enough significance was attached to coal-formed gas.

In the past we regarded natural gas an an associated gas of oil fields, and we only looked for gas in oil fields. Thus, the gas resource was not extensive. In reality this is not so.

There are two main types of natural gas from the point of view of the formation of the gas: one is the decayed mud type, i.e., oil field gas; the other is the decayed vegetation type, i.e., coal-formed gas. We are well acquainted with oil field natural gas, but not many people know of coal-formed gas.

It was not until the latter part of the 1950's, when the Soviet Union and the Netherlands discovered huge gas fields over coal beds and not over oil fields, that people learned of the existence of coal-formed gas and began to pay it some attention. The present theory is that at all stages in the formation of coal, organic gasses are continually given off due to the high temperature

and pressure, chief among them methane (CH_4) and carbon dioxide (CO_2). It is the least at the lignite stage, which produces an average of 38 to 68 cubic meters/ton; at the anthracite stage every ton produces 346 to 422 cubic meters of natural gas. This is what is called coal-formed gas. Most of these gasses escape to the surface via fissures, and are lost. Two types can be collected and utilized. One is mine gas, absorbed into the coal beds (forming from 3 to 24 percent of the coal-formed gas) and released when the coal is mined, something very harmful to coal mining. Another type migrates along fissures until it collects under favorable capping conditions, and this is called accumulated coal gas (accounting for 1 to 15 percent of the coal-formed gas). If we could find and accelerate uses for these two usable gasses we would create huge riches with a single stroke.

Mine gas, now rather well known, is now being collected and transmitted for domestic use. The Fushun, Yangquan and Kailuan mines average 180,000,000 cubic meters per year, enough to supply 24,000 households. But mine gas is rather scattered and hard to collect. Right now 2.6 billion cubic meters/year of gas are vented, polluting the atmosphere and wasting the resource.

However, the development of coal-formed gas requires even more attention.

II. The world's natural gas resources may exceed those of petroleum.

According to estimates by foreign scientists, the world's geologic reserve of coal is 16,000 to 20,000 billion tons. Figuring an average of 200 cubic meters of coal-formed gas per ton of coal, 3,200,000 to 4,000,000 billion cubic meters of gas could be produced. If 2 percent were collected, there would still be 64,000 to 80,000 billion cubic meters of accumulated coal gas. The world's present known reserves of natural gas are 67,000 billion cubic meters. The Soviet Union alone has theoretical reserves of 80,000 billion cubic meters, and proven reserves of 31,000 billion cubic meters. We can see that the accumulated coal gas resource could exceed this by very, very much. If we calculate at the rate of 3 percent, accumulated coal gas could reach 96,000 to 120,000 billion cubic meters, about equal to a reserve of 96 to 120 billion tons of oil, equal to one and one-half times the present proven reserve of oil, 77 billion tons. Therefore, nations are making the study of and exploration for coal-formed gas a key energy resource development goal. In fact, the speed of the increase in natural gas reserves has already exceeded the speed of increase in oil reserves by 200 percent. In the period from 1960 to 1980 the ratio of oil to gas reserves changed from 2.8 : 1 to 1.1 : 1.

As of today there have been discovered 26 large gas fields in the world, 16 of them are accumulated coal gas types, and proven accumulated coal gas accounts for 70 percent of the reserve. Five of the 26 largest gas fields are solely accumulated coal gas fields.

Certain prominent examples are: in 1955 the Soviet Union's proven natural gas reserve was only 3,900 billion cubic meters, the amount produced only 9 billion cubic meters (about the same as China's present average). Later, as large gas fields were discovered one after another in western Siberia, the Ministry of Natural Gas was established in 1959, to increase exploration and

development, and reserves and production quickly shot up. By 1965 proven reserves had increased to 3,200 billion cubic meters and production to 126.7 billion cubic meters. In 1982 proven reserves reached 31,700 billion cubic meters, and production reached 501.1 billion cubic meters of coal-formed gas. The percentage of natural gas in the energy resource structure climbed from 8.9 in 1960 to 22.8 today. The proportion of natural gas used as fuel or raw material is: ammonia, 83 percent; chemical fertilizer, 95 percent; copper and iron smelting, 93 percent; electrical generation, 50 percent. For everyday livelihood it is used in 2,000 cities and towns and settled areas of 10,000 or more, with a total population of about 200 million people. Even in Donbass, the coal capital, natural gas has taken the place of coal. Of the six large gas fields in production there, five are of the accumulated coal gas type. Accumulated coal gas production accounts for over 65 percent of the natural gas production. Donbass is an old coal field that has been worked for many years, still, a reserve of 60 billion cubic meters of natural gas been found.

Or again, in the Netherlands, where only 200 million cubic meters of natural gas were produced in 1958, the large Groningen gas field was discovered in the southern part of the North Sea in 1959, with accumulated coal gas reserves of 2,000 billion cubic meters. By 1976 the production rate reached 97.3 billion cubic meters/year, making the Netherlands the world's fourth largest producer. Natural gas's proportion in Holland's energy mix jumped up from 1.8 percent in 1958 to 97.6 percent, and still a small amount was exported to various countries in Western Europe. In the wake of Holland's discoveries in the southern North Sea, Denmark, England, Norway and West Germany discovered another 80 accumulated coal gas fields, with proven reserves of 4,000 billion cubic meters. England has become the world's number five producer.

The position of natural gas among energy resources can be seen from the following comparisons:

By ratio of proven reserves of coal, oil and gas: In the world, 1,117 (billion tons) : 77.7 (billion tons) : 67,000 (billion cubic meters); in the United States it is 3,600 : 47 : 5,700; in the Soviet Union it is 2,700 : 80 : 31,000. The world coal to gas ratio is 16 : 1. In China it is 2,200 : 1. The oil to gas ratio in the world is 1.1 : 1. In China it is 25 : 1.

By the ratio of present production: For the whole world it is 4.2 (billion tons) of coal : 3.0 (billion tons) of oil : 1,500 (billion cubic meters) of gas. In the United States it is 7 : 4 : 6. In the Soviet Union it is 7 : 6 : 5. In China it it 6 : 1 : 0.1. The world coal to gas ratio is 3 : 1, for China it is 50 : 1. The world oil to gas ratio is 2 : 1, for China it is 8 : 1.

China's reserves of coal and coal production are no smaller than those of the United States or the U.S.S.R., but China has much less oil; China's gas reserve is even smaller, almost negligible. On the one hand this speaks to the great distance China lags behind those countries; on the other hand it speaks to the fact that the potential is very great, that we need to urgently seek to increase exploration for and development of natural gas.

III. The prospects for China's natural gas resource.

China has rich coal deposits; there are proven reserves of 640 billion tons of coal at depths of less than 1,000 meters. Some experts estimate the coal-formed gas resource amounts to 1,800 to 5,000 billion cubic meters. If we base our calculations on the prospects of their being 5,000 billion tons of coal at depths of less than 2,000 meters, then China would have about 12,000 to 15,000 billion cubic meters of coal-formed gas, or discounting half as barren zones, then there would be 6,000 to 7,500 billion cubic meters. Experts in geological and petroleum sectors estimate that it could be in the 11,000 to 19,000 billion cubic meters range, less than the U.S.S.R. and more than the United States. The coal beds that may lie below 2,000 meters could produce even more; these are all important conditions for the production of coal-formed gas.

China has already discovered 27 coal-bearing basins with a surface area of more than 10,000 square kilometers each, or a total of 155,000 square kilometers, one-sixth of China's surface area. Some of these basins show good indications of natural gas.

For example, analysis of the strata and the gas composition of the Dongpu Wenliuzhuang gas field shows it to be of the accumulated coal gas type. Initial proven reserves amount to 45 percent of the natural gas at Dongpu, and according to those in the geology sector, similar accumulated coal gas fields could be found throughout the entire South Huabei Basin, with an area of 150,000 square kilometers and extending to Shijiazhuang in the north, Jiyuan in the west, and the Dabie Shan in the south.

Or another example, the Sichuan Basin, where seven or eight areas gas fields have been found in the northwest sector. All are of the accumulated coal gas type.

Or again, the Ordos Basin of Shaanxi, Gansu, and Inner Mongolia, where gas producing conditions are very good, and where several gas fields have been discovered. The daily production of the Liujiazhuang well near Yinchuan is nearly 180,000 cubic meters.

And again, there is the East China Sea Basin, where gas indicators were seen in 4 wells drilled and "Pinghu 1" found 102 coal beds in the Tertiary coal series. Among them were found 41 oil and gas bearing beds 144 meters thick, and a gas test showed 410,000 cubic meters of natural gas, proving it to be of the accumulated coal gas type. In the neighboring territory of Taiwan Province, 14 wells were drilled and 13 were accumulated coal gas type wells; the proven reserve of natural gas in 1978 was 500 billion cubic meters.

The above examples all show that several accumulated coal gas fields have been found in China, and the prospects for the future are bright. However, as we are just beginning to realize, our study, reconnaissance, and exploration work in the field of coal-formed gas is still very weak. Thus, speaking as a whole, the circumstances surrounding China's coal-formed gas are still quite unclear. At the end of 1982 coal-formed gas accounted for 10 percent of China's proven natural gas resource.

If we really buckle down, we should be able to find a natural gas reserve of 1,500 billion cubic meters in the next 5 years, with annual production of up to 50 billion cubic meters. This would equal about 50 million tons of crude oil, and give us some freedom. If 40 percent of it were used to make synthetic ammonia, then we could build 50 nitrogen fertilizer plants of 30-ton capacity, with an annual production rate of 15 million tons of synthetic ammonia and 26 million tons of urea, and this would basically solve our nitrogen fertilizer supply problem. Of the remaining 30 billion cubic meters, half could be put into household use and take care of 12 million households; and half could be supplied to industry, taking the place of 15 million tons of oil or 22 million tons of coal. China's energy structure and chemical fertilizer structure are about to undergo profound changes. The prospects for natural gas show that it can be done, but we must make a tremendous effort.

IV. Some suggestions.

1. Increase our understanding. According to the above analysis, we see that developing natural gas will be one important route toward solving our energy problem. In the last few years the capital investment in natural gas reconnaissance and exploration has been very slight, there are few facilities, there is little in the way of intelligence reports, study, or exploration personnel for natural gas, the development of work has been inadequate, and natural gas production has actually shown an annual decline. We suggest increasing investment in reconnaissance, exploration and development. Additional advanced equipment should be found locally or imported, we should strive to make a real breakthrough in about 5 years. The exploration for and development of natural gas should be added to the state planning targets for relevant sectors.

2. Unify leadership. Currently the reconnaissance and prospecting for coal-formed gas is divided three ways; the Ministry of Coal Industry is in charge of it down to 1,000 meters; the Ministry of Petroleum Industry is in charge of it in the areas of oil fields, but as their mission is pressing, they often discard natural gas; the Ministry of Geology and Mineral Resources carries out reconnaissance only; the Ministry of Chemical Industry is responsible only for utilization. An important reason for our long natural gas impasse is that our efforts are so scattered. We suggest the four ministries, based on the foundations of the work being done now, create an Office of Natural Gas Development, or a Bureau of Natural Gas Industry. This would speed up the development of natural gas by unifying the burden and the coordination of natural gas exploration, development and utilization.

3. Study the advanced experience of other countries, and quickly raise our level of technical expertise. Prospecting for and developing natural gas is a bit more difficult than prospecting for and developing oil. Overseas developments have been very rapid these last few years, so we suggest sending several groups to study and investigate in the concerned countries, and bring back the most crucial patented technology. When necessary, we should carry out joint exploration and development.

4. Adopt certain policies favorable to the development of natural gas, such as adjusting prices, using gas to develop gas, joint gas-fertilizer operations,

using gas to meter oil or coal in oil fields and coal mines, etc. We urge the development of more natural gas, and the acceleration of natural gas development. As for that gas that is being released into the atmosphere, we must seek some temporary measures to recover and use it.

5. While developing accumulated coal gas, to continue to pay attention to the development and use of mine gas.

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OIL AND GAS

BRIEFS

FINAL FIGURES IN ON 1984 CRUDE OUTPUT--Beijing, 1 Jan (XINHUA)--The year 1984 marked a crucial turning point for China's petroleum industry. Crude oil production has fluctuated since 1978 when the total crude oil output for the entire nation broke the 100 million-ton mark. The latest figures show that in 1984, crude oil output rose to a new level with total production reaching 114 million tons, more than 8 million tons more than the 1983 output. Good news was received from fields across the nation, from the Songliao Basin to Shengli, from Inner Mongolia to the Tarim Basin and the Junggar Basin. The proven geological reserves were up some 500 million tons over 1983, which assured the 1984 increase and guarantees a bright future for the nation's oil industry. [Summary] [Fuzhou FUJIAN RIBAO in Chinese 2 Jan 85 p 2]

1984 EXPORTS SET RECORD--Beijing, 16 Jan, XINHUA -- According to the latest news from the China National Chemicals Import and Export Corporation, China exported more than 28 million tons of petroleum [products] in 1984, a 40 percent increase over 1983 and a new record. This amount also represents one-fourth of the foreign exchange earned from all exports. The petroleum [products] exported in 1984 consisted primarily of crude oil, gasoline, kerosene, light and heavy diesel oil, lubricating oil, avgas, fuel oil, and naphtha. Consumers of these products included Japan, Brazil, the Philippines, Thailand, the United States, Italy, Singapore, and Hong Kong. Formerly an oil-importing country, China became basically self-sufficient in petroleum products in 1963 and significant oil exports begun in 1973. [Excerpts] [Xi'an SHAANXI RIBAO in Chinese 17 Jan 85 p 4]

NEW PETROLEUM MARKETING COMPANY--Beijing, 26 Dec (XINHUA)--The China National Petrochemical Corporation Marketing Company, which was inaugurated today, officially announced that, beginning 1 January 1985, unified operation and management of China's petroleum products will be put under a marketing company, a newly inaugurated company that will be mainly responsible for the planned distribution, marketing, management policies, and import and export work. The combination of production and marketing of China's petroleum products will accelerate the development of the petrochemical industry, meet the needs of the development of the national economy and foreign trade, and enhance enterprise and social economic results. [Beijing XINHUA Domestic Service in Chinese 1422 GMT 22 Dec 84 OW]

U.S. SEISMIC TEAM AT DAQING--Daqing oilfield in Heilongjiang has hired two American seismic teams to explore the oil gas reserves in the periphery of the oilfield. The first group of the teams went to the Qijia prospecting area to complete various preparatory tasks on 22 December. The seismic teams were employed from the Western Geological Company of the United States, to work here for 2 years under contract. [Harbin HEILONGJIANG RIBAO in Chinese 23 Dec 84 p 1 SK]

DAQING CONSTRUCTION--The Daqing Petroleum Administrative Bureau in Heilongjiang prefulfilled by 27 days its annual construction plan for production. According to statistics compiled on 16 December, Daqing oilfield newly built 3 large joint stations, 30 transfer stations, 128 measuring stations, 867 oil wells, and 346 water wells, laid 1,635 km of pipelines, and erected 299 km of power lines. Newly added crude oil production capacity reached 4.35 million tons, 20 percent more than last year. [Excerpt] [Harbin HEILONGJIANG RIBAO in Chinese 18 Dec 84 p 1 SK]

DAQING 1984 OUTPUT, PROFITS--In 1984, the Daqing Oilfield, Heilongjiang Province, turned over 3,457,000,000 yuan of profit and tax to the state, 68 million yuan more than the 1983 figure. Crude oil output reached 53.56 million tons, overfulfilling the state target by 1.56 million tons. [Harbin Heilongjiang Provincial Service in Mandarin 2200 GMT 13 Jan 85 SK]

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NUCLEAR POWER

ECONOMIC STUDY COMES DOWN IN FAVOR OF NUCLEAR POWER PLANTS

Chengdu HE DONGLI GONGCHENG /NUCLEAR POWER ENGINEERING/ in Chinese No 6, Dec 84 pp 50-53

/Article by Cui Lunyuan /1508 0243 0337/

/Text/

I. A thermal-electric power plant has two products: heat and electric power. The overall thermal efficiency of a thermal-electric power plant is much higher than that of a conventional fuel-fired power plant. Currently the standard coal consumption rate of the most efficient coal-fired generators in this country is approximately 330 g/kWh whereas the two thermal-electric power plants in Shanghai have a coal consumption rate of 300 g/kWh. However, in Luo's article, he used the figures 335 and 350 g/kWh in comparing economic performance: obviously this would result in lower economy for the nuclear-thermal power plant.

For the Jinshan nuclear-thermal power discussed in the article, the single reactor thermal power output is 450 MW. With a hourly supply of 75 tons of medium-pressure steam and 320 tons of low-pressure steam, the available power output after subtracting in-plant electric power consumption is 50 MW. The combined thermal efficiency is approximately 80 percent, and approximately 70 percent of the reactor total output is used for heat supply. In evaluating the economic benefits of heat utilization, we use a very conservative approach by assuming the efficiency to be the same as that of power generation, thus the energy of heat supply corresponds to

$$50 \times \frac{70}{100-70} = 116.7 \text{ MW}$$

Therefore, each reactor of this nuclear power plant can produce the equivalent of 166.7 MW of electricity, which is 133.3 percent of 125 MW. Based on this figure, the specific investment becomes

$$2340 \div 133.3\% = 1760 \text{ yuan/kW}$$

and the cost of electricity will also be reduced to 4.5 cents/kWh. As a consequence, the final conclusion given in the article is questionable.

Another method of calculation is to estimate the total production cost of the nuclear-thermal power plant. The total cost can be divided into three parts: fuel cost, depreciation, and other expenses; the first two can be calculated using the method described in Luo's article, the last term can be estimated by using a number somewhat higher than the actual expenses of existing oil-fired power plants (whose capacity is approximately 50 percent greater than that of nuclear-thermal power plant). The "other expenses" of existing oil-fired power plants are approximately 7.5 million yuan, which is quite close to the figure of 10.2 million yuan estimated in Luo's paper. Thus, one can simply use Luo's method to calculate the total cost of a nuclear-thermal power plant:

$$2 \times 12.5 \times 8760 \times 0.70 \times 0.93 \times 0.05974 = 85.5 \text{ million yuan}$$

The current cost of steam supply by oil-fired power plants is approximately 13 yuan/ton; the fuel cost of small coal-fired furnaces for low-pressure steam is mostly over 10 yuan/ton. Hence it is reasonable to assume the steam supply cost for nuclear-thermal power plants to be 13 yuan/ton. Thus the fraction of annual plant expenses attributed to steam generation is

$$2 \times (75+320) \times 8760 \times 0.7 \times 13 \div 10000 = 63 \text{ million yuan}$$

and the cost of electricity should be

$$(8550-6300) - (2\text{x}5\text{x}8760 \times 0.7) \times 100 \div 3.67 \text{ cents/kWh}$$

which is lower than the figure obtained previously. In fact, this is a conservative estimate.

II. According to Luo's analysis, for strictly power generation, the specific investment and the cost of electricity both decrease with increasing generator capacity, which is consistent with conventional rules. There should also be an economic dividing line between nuclear power plants and coal-fired power plants. In China today, where no sulphur removal is required from exhaust smoke, this dividing line is generally in the range of 300 MW and 1000 MW. This estimate is consistent with those obtained by other countries and should be non-controversial. But for nuclear power stations which are used by the petro-chemical industry to replace oil-fired power plants, the same argument no longer applies. Once the operation of the Jinshan nuclear-thermal power plant has stabilized, it can replace 450,000 tons of fuel oil. By converting this amount of oil into raw chemical material, one can expect to generate sufficient economic benefits to recover the investment in just a few years. Even when treated as fuel, this oil is equivalent to a price of prime coal of 70.6 yuan/ton based on the existing crude oil price including tax; this is slightly higher than the estimated 1990 Shanghai coal price of 38 + 28.2 = 66.2 yuan/ton given in Luo's article. Using this price figure, the cost of electricity for the 1000 MW coal-fired power plant after being converted to the use of taxed fuel oil will be 4.45 cents/kWh, which is higher than the cost previously estimated for nuclear power generation. In other words, the cost of nuclear power generation will be lower than the cost of oil-fired power generation based on the current oil price including tax, even though the capacity of the generator units is increased to 1000 MW.

In comparing the relative investment between nuclear and coal for Shanghai's Jinshan nuclear power plant, it is inappropriate to use average numbers, particularly those concerning the cost of transportation of coal. The location of a thermal power station is very limited because it must be close to the point of steam users; therefore it is difficult to select a location which is also close to transportation. In the case of the Jinshan power plant increasing its coal shipment by land would require building a new railroad and a bridge across the Chang Jiang because the existing Shanghai-Hangzhou railroad, the Shanghai-Ningbo railroad, and the Tianjin-Pukou line have already reached saturation; thus the specific investment will nndoubtedly be higher than the average figures. Increasing the shipment by sea would require building a new harbor because the shipping volume of Shanghai Harbor has already exceeded its design capacity. It is estimated that to build a single dock at the Shihua plant will cost over 100 million yuan; based on an annual shipment of 1 million tons of coal, this translates into an investment of over 100 yuan per ton of coal; if one also takes into account the cost of vessels as well as docks and railroads in the north, the final figure may very well exceed the 150 yuan/ton estimate of Luo's article. Furthermore, Luo's estimate of specific investment of 900 yuan/kW for coal-fired power stations is rather low. If one considers sulphur removal from exhaust smoke (the average investment in the U.S. is approximately 100 dollars/kW), then the estimate will significantly exceed this figure. Therefore, as far as the Shihua plant is concerned, a nuclear-thermal power plant would be more economical than a coal-fired power plant.

III. From the point of view of strictly nuclear power development, I agree with Luo's conclusion that the economy of a power plant improves with increasing generator capacity; this is also consistent with the conclusion reached by other countries. But we must also consider the reality of China's current conditions and constraints.

First, we must consider the practical condition of China's power network. Installing large generator unis requires sufficiently large network capacity and strong network structure. Even in the East China network which has a capacity of over 10,000 MW, its network structure must be improved if we were to install large generators of the 1,000 MW class. In the southeast part of this country, many regions such as Fujian, Jiangxi, and the island of Hainan are not likely to be connected to a major network in the near future; they are also poor in coal resources and their access to transportation for coal shipment is much worse than Shanghai. If nuclear power is to be the solution of the energy problem for these regions, it may be necessary to use relatively small generator units. According to the analysis given in Luo's article, for the Guangdong region there is little difference in economic performance between coal and nuclear power of the 125 MW class: it is also pointed out that the coal price and shipping cost used in the calculation were rather low. Therefore, under China's current conditions, one cannot totally rule out the future use of small generator units.

Second, we must consider the practical condition of China's manufacturing industry. There is no doubt that we should develop the capability to manufacture large nuclear power equipment. But to reach this goal requires a great deal of hard work. We must try to import technology from abroad and to build up our inventory of equipment, both of which require money and time. Furthermore, in order to import technology we must first import a certain quantity of expensive equipment. The specific investment for building power stations with imported equipment is far beyond the range of 1500 to 2500 yuan/kW. However, China currently already has the facilities and experience to produce the equipment for medium and small size nuclear-thermal power stations. In particular, since in a heat-generation type steam turbine large amounts of steam is extracted from the initial stages, the degree of difficulty in manufacturing the long blades, the low-pressure cylinders, the regenerators and the large condensers is considerably reduced. Therefore, as we proceed to develop the capability of manufacturing large nuclear power equipment, it may be prudent to pursue a parallel course of developing medium and small size nuclear power stations. Furthermore, with careful overall planning, the production capability of these medium and small stations will be of sufficient value even after the year 2000 to serve as supplement power source to the large facilities. In fact, with China's vast territory and diverse conditions, it is difficult to say that there will not be a market for small nuclear power facilities. Evidence of this fact is the current installation of 125 MW fuel-fired generator units in the East China power network.

Third, we must investigate all the elements that may potentially utilize the heat supply from nuclear energy. The steam generated by nuclear-thermal power plants can satisfy the steam requirements of most industrial operations. As long as there is a concentration of steam load, we may consider the possibility of building a nuclear-thermal power plant in the surrounding region. As pointed out earlier, because of the high thermal efficiency and superior economic performance of nuclear-thermal power plant, the cost of power generation is much lower than a nuclear power plant with the same capacity. The manufacturing of equipment for medium and small nuclear-thermal power plants is a relatively easy problem. Thus, as long as the safety issue can be resolved, the future of this type of nuclear-thermal power station should be quite promising. Recently, I had the opportunity to visit the Midland nuclear-thermal power plant in the U.S. Its safety measures and thermodynamic system for nuclear steam generation are basically the same as those used by the Jinshan nuclear-thermal power plant. The plant is separated from the Dow Chemical Co by a small river, and in the opinion of the NRD, the design units and the electric power company provide adequate protection to meet the required safety standards. According to our own calculations, we can be quite confident that the radioactive dosage in the surrounding environment and in the steam supply will be lower than the specified level by a fairly wide margin.

Because of the limited transport distance of industrial steam, the generator units of nuclear-thermal power stations cannot have very large capacity. Since there are a fairly large number of fuel-fired thermal power plants like the Jinshan power plant whose economic performance is competitive with large power plants, it is worthwhile to consider building nuclear-thermal power plants as part of China's policy to develop its nuclear power industry.

In developed countries where the degree of electrification is high, primary energy sources are generally converted to electric energy prior to consumption. Therefore, the utilization of nuclear energy is primarily concentrated in large nuclear power plants. However, the situation is quite different in this country; there are many occasions where heat energy is being used directly. China currently has more than 200,000 industrial furnaces whose fuel consumption is as high as 140 million tons of standard coal per year, which is more than the coal consumption of all the coal-fired power plants in this country. Furthermore, many areas have a high concentration of these small furnaces. For example, once the Nanshi power plant in Shanghai is converted to a thermal-electric power plant, over 300 chimneys in the surrounding area can be eliminated; thus the conversion not only provides substantial energy savings but also results in improvement of the environment. In Shanghai, there are many locations where several hundred furnaces can be found within a very small area; they are all potential targets that may benefit from nuclear-thermal power plants.

Last year Qinghua University successfully developed a nuclear heating system using hot water as a medium. Because of its low operating temperature and low pressure, this type of thermal reactor is safer and simpler to manufacture. Therefore, it is entirely feasible to install these units in populated urban centers and its manufacturing cost can be significantly lowered. Even though the demand for heating is highly seasonal and the number of hours of utilization per year is limited, it may still be economically justifiable to replace the large number of inefficient heating furnaces by small capacity thermal power units. Today many foreign countries are conducting research in this area; some already have comprehensive design plans. Northern China has a large area which requires winter heating and consumes a large amount of energy; the heating furnaces are also a major source of pollution in urban areas. Replacing these small furnaces by nuclear energy will produce double economic benefits.

In conclusion, as we proceed with the development of China's nuclear energy, our efforts certainly should not be limited to building only large nuclear power plants of the 1000 MW class. Under certain conditions we may consider building a number of medium-sized nuclear power plants. We whould also explore the use of nuclear energy for heat supply; there

appears to be a promising future in this country for small nuclear-thermal power plants that supply steam or even smaller power stations that supply hot water. In some sense, developing nuclear energy for heat supply may be a strategy that better satisfies China's current needs.

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CONSERVATION

GREATER ENERGY EFFICIENCY, CONSERVATION VITAL TO NATION'S ECONOMIC GOALS

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/Article by Sun Xing /1327 5281/: "Despite Rich Energy Resources, China Must Strengthen Conservation Measures"/

/Text/ China's energy resources are abundant, varied and ever increasing. Judging by its total coal, oil, natural gas and hydropower reserves, it must be considered one of the world's richest nations in terms of energy resources. In 1983, it produced 700 million tons of raw coal, 105.99 million tons of crude oil, 75 million tons of refined oil, 11.93 billion cubic meters of natural gas and 349.3 billion kWh of electricity. Compared to 1952, coal production rose 9.2 times, crude oil 240 times, natural gas 1,488 times, and electricity 46 times. China today numbers among the world's major energy producers, ranking 3d in coal production, 6th in oil production and electric generation and 12th in natural gas production.

Since the founding of the People's Republic, China's energy industry has undergone marked structural changes. Formerly a producer of coal and little else, it has now diversified into other energy resources while maintaining the primacy of coal. The proportion of coal in overall energy output has dropped, however. At the same time, oil, natural gas and hydropower output has risen. From 1965 onwards, China has been self-sufficient in crude oil.

The Natural Distribution and Utilization Characteristics of Energy Resources

China's natural energy resources are unevenly distributed: 1) About 64 percent of coal deposits are concentrated in north China; 2) Oil is mostly found in the Norheast which accounts for 51 percent of total resources (excluding offshore oil); 3) About 93 percent of hydropower is concentrated in the Southwest, Central China and the Northwest.

China differs from most other countries in the way it utilizes energy resources. There are four utilization characteristics: 1) Its abundance in energy resources enables it to be a marginal exporter, apart from meeting its own needs; 2) Coal has consistently maintained its leading position in China's energy mix, accounting for about 70 percent of total energy output; 3) Industries, including the energy industry, have been the dominant energy consumers, taking up 70 percent of energy consumption; and 4) Rural areas depend mainly on biomass

energy. The amount of firewood and manure consumed reaches 220 millions of standard coal, or 68 percent of total rural energy consumption. Eighty percent of rural energy is consumed for domestic purposes. Of this amount, 86 percent is derived from biomass energy; 5) Energy consumption per unit of output is high. Coupled with low utilization rates, this leads to gross waste; and 6) At 0.6 ton of standard coal, which is not even one-third of the world average, per capita energy consumption in China is every low.

Kinds of Energy Resources and Their Production

1. Coal--As far as coal is concerned, China is one of the best endowed countries in the world. It has the third largest reserve, after the United States and the Soviet Union. In terms of economically exploitable deposits, China ranks only after the United States.

China's coal industry is concentrated in the north, where Shanxi has the richest deposits. Verified reserves in that province amount to 203.5 billion tons, constituting China's largest coal production center. Based on its present annual output of 150 million tons, the area can remain productive for the next 1,000 years. Its annual output is expected to top 400 million tons by the year 2000.

Inner Mongolia is China's second largest coal production center. With 192 coalfields and 194.2 million tons of proven reserves, the Inner Mongolia Autonomous Region accounts for one-quarter of the nation's verified reserves, exceeded only by Shanxi. Presently the region produces 20 million tons of raw coal each year. Only 1.9 percent of verified reserves have been mined over the past 30 years. In coal variety, geological structure and mining conditions, Inner Mongolia mines closely resemble those in Shanxi and are mostly suited for opencast mining. Regional coal output by the end of the century will increase 8 times over current production while output value will jump 10-fold. It will then become China's second largest coal production center after Shanxi.

With 22 billion tons of verified reserves within 1,000 meters from the earth surface and 2,000 square meters of coal-bearing area, the Huainan and Huanbei region is China's another important coal production center. This region has thick coal seams, produces a full range of high-grade coals and is close to Shanghai, Jiangsu and Zhejiang. Strategically located and easily accessible by land and water, it has excellent development potentials. Huainan and Huaibei coal mines account for 99 percent of the province's reserves and 52 percent of total reserves in East China. To relieve energy shortage in East China, the state has designated coal development in the two Huais as a key construction project, which will transform the region into the coal production center of East China.

2. Oil--Oil is a precious, high-quality and multipurpose resource, irreplaceable by coal. Consequently, China's remarkable breakthrough in oil exploration and spectacular increase in production will transform its energy outlook and usher in a new era in economic growth. It is vital to the realization of the country's economic development objectives this century.

With its fairly rich oil reserves, China is one of the six nations in the world which have an annual oil output over 100 million tons. Its geological oil reserves have been estimated at between 30 and 60 billion tons. However, its present verified oil reserves amount to only 7 billion tons while verified natural gas reserves fall short of 50 billion cubic meters. China's oil resources are mostly found in the eastern and western parts of the country. A reconnaissance survey has come up with over 300 sedimentary basins where oil prospecting can be carried out. Sedimentary basins on land cover a total area of 4.5 million square km. Sedimentary rocks in the continental shelf off the coast have been estimated at 3.33 million square km. They abound with oil and natural gas reserves and constitute the material basis for China's oil wealth.

The distribution of China's verified oil and natural gas reserves on land, based on 1980 data, is given in the following table.

Region / Item	National	N.	Northeast	E.	South-central	SW	NW
oil	100	16.1	50.8	16.2	4.6	-	12.3
natural gas	100	8.4	12.6	3.0	3.9	67.5	4.6

N.=North E.=East SW=Southwest NW=Northwest

To judge by the area of sedimentary deposits, China's offshore oil reserves may reach 17 billion tons, making it Asia's second largest offshore oil and natrual gas strategic region. Within this region, the minimum reserves of Donghai Basin and the Zhujiang River estuarine basin are 8.75 billion tons and 4.55 billion tons, respectively.

It is projected that by the year 2000, China's oil output will reach 200 million tons, with drilling on land and at sea each accounting for about 100 million tons. Oil drilled inland will meet domestic consumption while oil drilled offshore will be exported to pay off the investments made by foreign oil companies.

3. Electricity--China currently faces an acute shortage of electricity which affects almost every electric network in the nation, except for some isolated spots in South China. It is estimated the country is short of 50 percent of its needed electricity generating capacity and 50 billion kWh of electricity. As a result, 20 percent of its industrial capacity is underutilized, which translates into a loss in output of 75 billion yuan. About 40 percent do the production brigades in the countryside have not yet been electrified.

China's hydropower resources, which amount to 680 million kW, are the richest in the world. Of this vast reserve, developable resources amount to 370 million kW, capable of generating 1,900 billion kWh of electricity each year. At present, China's hydropower stations have a combined installed capacity of 24.16 million kW and generate 86.3 billion kWh of electricity each year, which is only four percent of potential output. Every percent of hydropower developed is equivalent to drilling 5 million tons of oil or mining 10 million tons of coal.

The future development of electric power should be governed by the following policies: gradually raise the percentage of investment in electricity, progressively increase the emphasis on hydropower stations, build large-scale, coal-efficient thermal power stations, construct electric power stations in coal-producing areas, develop thermal power stations in peak-load areas and gradually build a super electric network. It is estimated that by 1990, give or take a few years, China will be covered by seven major electric networks and by the year 2000, the entire nation will be embraced by a unified network. The projected installed capacity of the nationwide network will then be 200 million to 240 million kW. Electric consumption at that time will have reached 1,100 billion to 1,300 billion kWh.

4. New energy resources--Fossil fuels are limited and nonrenewable. In the long run, human civilization will face a crisis in fossil fuels. We can avoid this crisis only by ceaselessly searching for new energy resources.

(1) Nuclear energy--Only 30 years have elapsed since man built his first experimental nuclear power station. During this period, 273 nuclear power stations have been constructed and put into operation in more than 24 countries and regions, with a combined installed capacity of 168.85 million kWh. In addition, 229 stations are being built with an installed capacity of 215.27 million kW. It is estimated that by 2000 about half of the world's nations will have nuclear power stations.

With its rich uranium resources and solid technological base, China is well equipped to develop a nuclear energy industry. In doing so, it should adhere to the policies of "emphasizing nuclear power," "combining nuclear power with thermal energy" and c oordinating military with civilian uses. Analyzing the situation from an economic viewpoint, East China and South China should give priority to nuclear power stations while North China and Northeast China should place equal emphasis on thermal electricity and nuclear energy in order to reduce the air pollution resulting from the burning of large amounts of coal for home heating purposes.

(2) Solar energy--Although it is one of the more promising and important new energy resources today, solar energy remains relatively insignificant in China's energy mix. Applied research in solar energy has yet to come up with a major breakthrough. Meanwhile, its economic feasibility is still very limited.

China abounds with solar energy resources and is one of the first countries to exploit them. Its annual radiation is estimated to be between 800,000 and 2 million kcal per square meter. Two points are worth noting about China's solar radiation: 1) The Western part of the nation receives more solar radiation than the eastern part. Their annual radiation values are 1.4 million to 2 million kcal per square meter and 800,000 to 1.6 million kcal per square meter, respectively; and 2) North China receives more solar radiation than South China. Each year, the former receives radiation ranging from 1.2 million to 1.6 million kcal per square meter, compared with South China's 800,000 to 1.2 million kcal per square meter. The Qinghai and Xizang plateau is well positioned to take advantage of solar energy. So are the Inner Mongolian plateau, which is more favorably located in this respect than North China, and some areas in western Sichuan and western Yunnan.

At present, solar energy is mainly used to produce thermal heat. Most of it is used to drive such installations as furnaces, water heaters, desiccators, air conditioners, desalination plants, welding machines, high-temperature furances and water pumps. The exploitation of solar energy should be a priority in villages so that it could help relieve the rural energy shortage.

(3) Wind power--As oil supplies declined with each passing day during the last few years, research organizations in some nations have been desperately searching for alternative sources of energy and have looked towards renewable energy resources as an answer. It was against these circumstances that the idea of using wind power to generate electricity emerged.

China is quite rich in wind power resources, particularly along the coasts of Southeast China, East China, North China and around the /offshore/ islands, where the annual wind speed averages 6 to 7 meters per second. Research on the use of wind power to generate electricity, which began in China in the 1950's, has gained momentum recently and made rapid progress. The largest wind-powered generating unit is on Shengsi Island, Zhejiang Province. It is 16 meters in diameter and has a capacity of 18 kW.

(4) Methane--Since the founding of the People's Republic, we have never solved the shortage of firewood among peasants. The burning of straw as a fuel achieves a heat utilization rate of only 10 percent, while taking a heavy toll on the agricultural ecosystem by creating a vicious circle and reducing soil fertility. On the other hand, with methane, which is produced by the decomposition of organic matter like straw and vegetation, we double the heat efficiency and increase the heat utilization rate by 50 percent. The exploitation of methane also provides a source of fertilizer, contributes towards environmental protection and public sanitation and constitutes an economically feasible way of using bioenergy.

Much of China is rich in methane resources. In 1979, villages nationwide produced manure and straw totalling 460 million tons in a dry state. Fermented at normal atmospheric temperature, this material could produce 122.46 billion cubic meters of methane, equivalent to 140 million tons of raw coal, as well as retaining the equivalent of over 10 million tons of ammonium sulfate and 1,800 million tons of organic matter. When fully utilized, it can supply each rural household with 1.94 cubic meters of methane, enough to satisfy its domestic needs. Therefore, the development of metahne is essential to solving China's rural energy problems.

Statistically, there are now 7.5 million methane-generating pits in China and over 35 million commune members use this energy resource. Nationwide, more than 50 scientific research units and institutions of higher education are currently engaged in research to increase methane production and improve economic results. Satisfactory progress has been made.

(5) Geothermal energy and tidal energy--Geothermal energy is widely distributed in China and can be found in all the 30 provinces and autonomous regions. It is particularly abundant in the two geothermal belts embracing the eastern coastal provinces and the Xizang Autonomous Region, Yunnan and Sichuan;

respectively. There are over 600 hot springs in the eastern coastal region, making up about one-third of the nation's hot water spots. With 700 hot springs, Southwest China is another major thermal zone where intensive prospecting and development are now underway at the Yangbajing thermal field in Xizang Province. Good results have been reported.

China's tidal energy resources are concentrated in Fujian and Zhejiang which account for 80 percent of the national total. At present China has only taken the first step towards the large-scale exploitation of tidal energy.

Let's Tap Potential and Conserve Energy

While China's total industrial and agricultural output value will quadruple by the year 2000, our energy output will only double, according to projections by relevant departments. In other words, half of the energy we will need to increase our output value four-fold must come from improved energy utilization rates and conservation. Consequently, we face a formidable conservation task ahead but the potential is considerable.

1. Let's examine our conservation potential by comparing our energy consumption per unit of output value with those in the Soviet Union, the United States, and Japan. In 1980, while we used 211,100 tons of energy to produce one unit of GNP, those three countries used 122,600 tons, 91,800 tons and 37,400 tons, respectively. It can be seen that China's energy consumption was 6.5 times that of Japan and 2.5 times that of the United States. Even when we manage to cut our energy consumption per unit of GNP by half, we would only match the Soviet level in 1980.

2. In China, 1 ton of standard coal generates 496 dollars worth of output. Corresponding figures for Japan, India, the United States, and the Soviet Union are $2,825, $1,265, $1,089 and $815, respectively. Holding energy input constant, we could only produce one-sixth and one-half of what Japan and the Soviet Union can produce, respectively. Although there are some factors which are not strictly comparable, the magnitude of the discrepancies does demonstrate that we are wasteful with energy.

3. Sixty percent of our technology and equipment date from the 1950's and 1960's. They are inefficient and consume an excessive amount of energy, constituting an impediment to raising energy utilization rates.

Water pumps nationwide have a total installed capacity of over 80 million kW and consume 60 billion kWh of electricity annually, which is 1.2 billion kWh more than that consumed by newer models in foreign countries. This translates into a utilization rate 20 percent lower than that achieved by newer equipment. After industrial boilers were fitted with economizers, efficiency went up 10 to 15 percent and output, 5 percent. After electric industrial boilers were modified to supply heat as well as generate electricity, efficiency again increased by at least 15 percent. These are vital conservation measures. If the heat efficiency of existing industrial boilers is raised by five percent across the board, the country can save about 10 million tons of standard coal each year.

China's coal consumption for household purposes amounts to about 80 million tons. The heat efficiency of domestic kitchen ranges varies from 15 to 18 percent. By increasing this rate to 40 percent, which is highly possible, we will use 40 million tons of coal less annually.

We could conclude from the above that we must seriously strengthen scientific management, rely on scientific progress and go all out to save energy if we hope to catch up with the world in energy development and conservation efforts. Only thus would we be able to realize our great objective of quadrupling our industrial and agricultural output value.

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JIANGSU COMPLETES 5-YEAR CONSERVATION PLAN

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[Text] Nanjing, 24 January (XINHUA)--Energy-short Jiangsu Province in east China has completed more than 500 energy conservation projects over the past 5 years which may save 835,000 tons of standard coal a year, says the provincial Planning and Economic Committee.

Jiangsu is a leading industrial province, with 1984 industrial output value growing 19 percent to 67.7 billion yuan. It had fulfilled the main targets of its Sixth 5-Year Plan by the end of last year, 1 year ahead of time. Its total industrial and agricultural output value reached 97.3 billion yuan in 1984, ranking first in China for the 4th consecutive year.

The province invested more than 270 million yuan between 1980 and 1984 in 728 energy conservation projects, mainly in chemicals, building materials, light, and metallurgical industries, where much of the equipment remains backward and wasteful of energy.

They mainly give furnaces and kilns energy-efficient equipment, update industrial boilers and fully use exhaust heat, and introduce energy conservation technology and materials.

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BRIEFS

SHANDONG ENERGY CONSERVATION WORK--Shandong Province has made new achievements in energy conservation work. In 1984, the province saved 1.24 million tons of standard coal, overfulfilling the annual energy conservation plan by 34 percent. The province completed 151 energy-saving technological transformation projects. [Summary] [Jinan Shandong Provincial Service in Mandarin 2300 GMT 6 Jan 85 SK]

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